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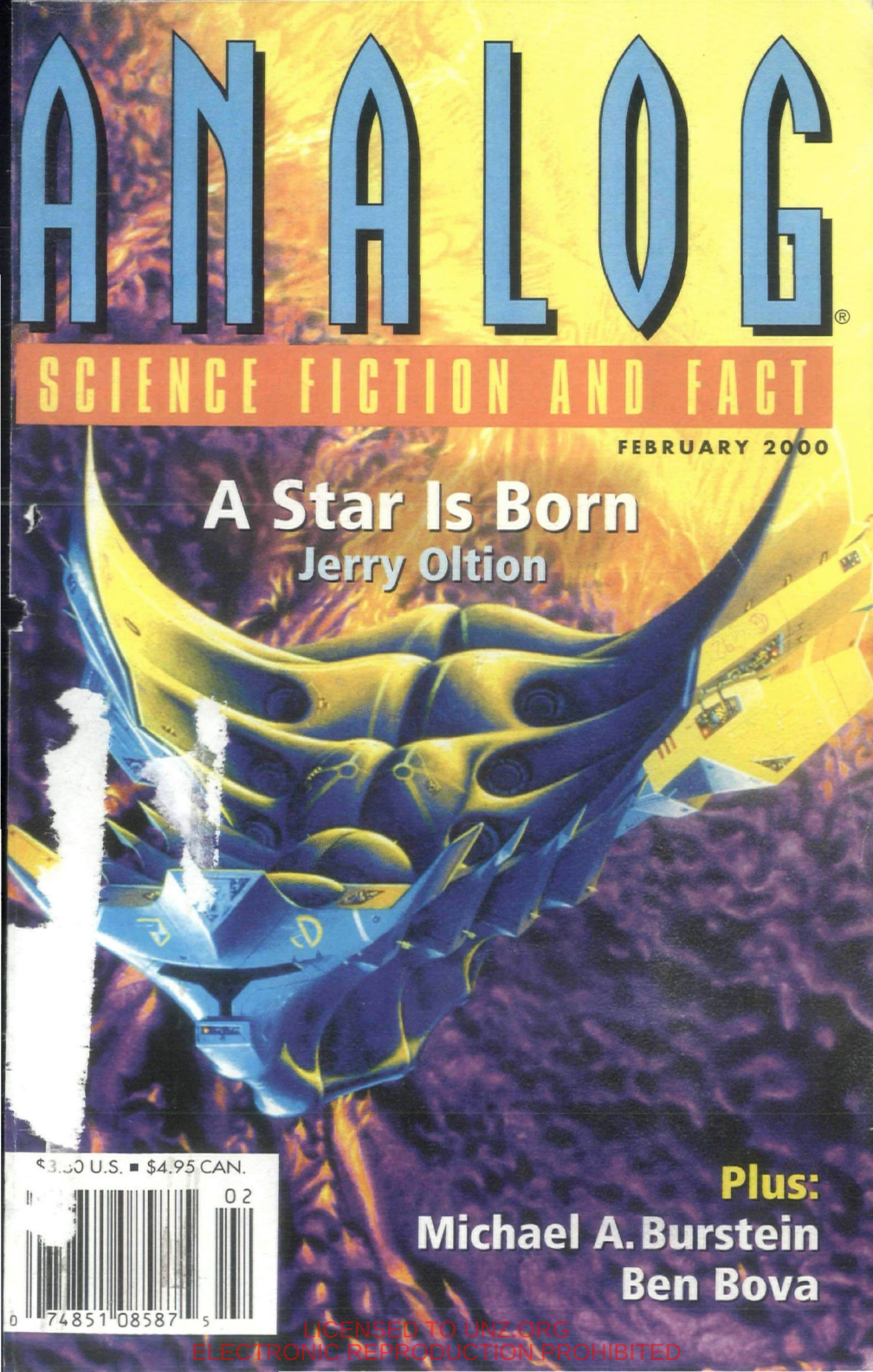

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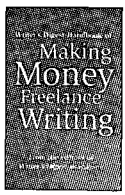

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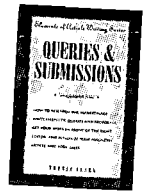

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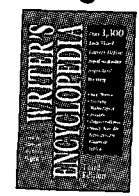

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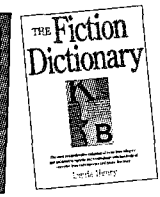

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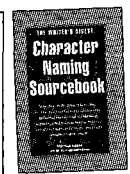

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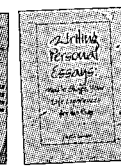

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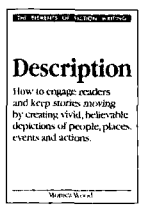
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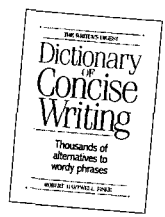

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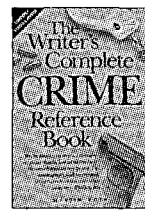

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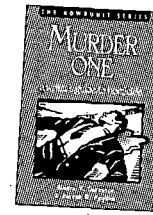

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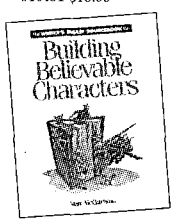

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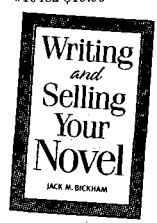

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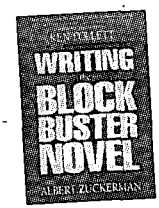

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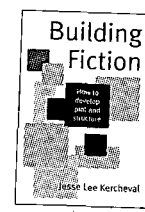

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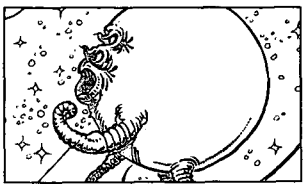

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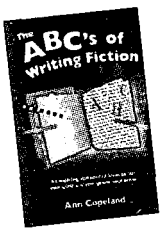

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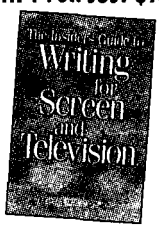

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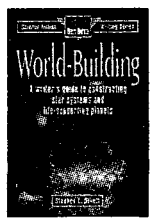

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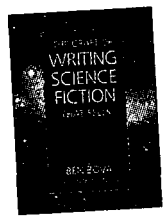

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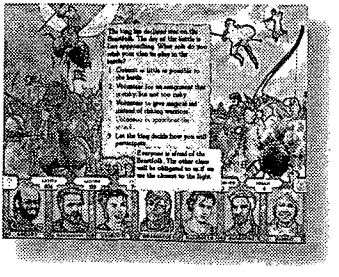

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EDITORIAL Stanley Schmidt

APPLIED MEMETICS

It's probably safe to say that most people in the United States strongly favor a free and unrestricted flow of ideas—or at least say they do. In practice, a great many of us can be driven to say, "Well, maybe an exception needs to be made in *this* case. . . ." That's especially true if the proposed restriction will only affect other people, or if we've recently been scared.

And might there be something to the idea that an exception *should* be made in certain cases?

If there's anything to the idea of "memes," a disturbingly good case can be made for it—and enough people have been scared recently that this is a good time to talk about it. As I write this, for example, the last couple of years have seen an alarming rash of violent incidents, some of them full-fledged massacres, in high schools scattered around the country. Nobody fully understands the reasons for this bizarre epidemic, but there has been a lot of finger-pointing and soul-searching and speculation and calls for action to prevent more of the same. One of the commonest themes in this search for solutions has been the notion that violent video games and web sites have spread ideas and attitudes that lead to such real-world violence, and therefore should be banned or at least strictly controlled.

In the language of "memetics," this diagnosis says that the root of the problem is the spreading of highly infectious and dangerous memes that lead to destructive behavior. "Meme," in case you haven't encountered it before, is a term coined by Richard Dawkins in his 1976 book *The Selfish Gene*, as an analog of a gene. (The concept was discussed at some length in the August 1987 *Analog*, in H. Keith Henson's article "Memetics and the Modular Mind—Modeling the Development of Social Movements," and in an accompanying editorial.) A gene is a replicating pattern of information that uses cells to make copies of itself; a meme is a replicating pattern of information that uses minds to make copies of itself. Examples range from a catchy tune that many people can't get out of their heads, to the social and political ideas that led to the Holocaust in mid-twentieth-century Germany and "ethnic cleansing" in much more recent Yugoslavia. Some, like the Edsel sales campaign, are weak and easily resisted; others have a powerful ability to capture human minds. Like genes, memes evolve by mutation and selection, the "weak" ones disappearing before they spread very far, the "strong" becoming dominant throughout entire populations.

The concept is not, at least so far, nearly as rigorously grounded as that of genes, which work by quite specific chemical mechanisms. But the parallels are striking enough to raise the intriguing speculation that memetics *could* conceivably become a reasonably rigorous and predictive science. And if memes *could* be precisely defined and their psychological effects and "infectiousness" quantified and predicted, it would be hard to avoid pressures to take active measures aimed at suppressing memes that were both destructive and highly infectious.

The scary part of that (and the part

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that poses an awkward dilemma), for the relatively few who seriously believe in the importance of free speech and the dangers of censorship, is that "suppressing memes" *means* censorship, pure and simple. Yet there is plenty of historical evidence that some memes *are* extraordinarily contagious, and also that some have lethal consequences. And if the evolution by selection analogy holds (and there is plenty of evidence for that, too), it's essential to remember that the phrase "survival of the fittest" is at least very close to tautological.

The "fittest" are *defined* as those things, be they organisms or ideas, that survive. That has absolutely nothing to do with moral virtue, or any kind of merit except success in terms of prevalence and/or longevity. The evolutionarily fittest may, for example, be those that can destroy the most competitors—a kind of success that may be ultimately self-destructive and thus turn in the long run to failure. Naïve faith that the "best" ideas will drive out "bad" ones is insupportable and inadequate. Some very bad ideas, such as Nazism, are very powerful and infectious. (And if you think that was just a historical fluke peculiar to the German people ca. 1940, you should read Keith Henson's account of an experiment in which a 1969 American high school teacher reintroduced it to a class and it spread like wildfire.)

Some ideas are "good" under certain conditions and "bad" under others (and not all people will agree on which are which). Military officers in situations where it was arguably necessary to kill enemies have found that many, or even most, of their soldiers were psychologically unable to do so until they were subjected to deliberate desensitization programs—which officers using them have described as quite similar to some of the video games in question. Should some agency be trusted to decide when such things are acceptable for public distribution and when they are not?

If so, who can be trusted to make that decision?

A defender of free speech, confronted with the gene-meme analogy, might argue that infectious memes don't need to be controlled as vigorously as infectious genes—e.g., viruses—because they're "just ideas." But such an attitude is inconsistent with the very idea that makes believers in free speech consider it so essential. Some ideas are profoundly influential; they can change the entire shape of a civilization and the direction of its history. Where, for instance, would the United States be without the widespread promulgation of the meme that "all men are created equal" (even if we're still struggling to get everybody to act as if they actually believe it)?

We're often told that, "Nothing is as powerful as an idea whose time has come," and there's a good deal of truth in that. But it's just as true whether that idea is good or bad. That is why people who fear that violent games and web sites lead to high school massacres

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would like to censor such things—and, from a strictly logical point of view, they're right. *If* their premise is true, and if preventing such incidents is a desirable thing, and if memetic epidemics and evolution really happen, then it follows that controlling the spread of the dangerous memes is also a desirable thing. If ideas can be simultaneously powerful, dangerous, and infectious, they *should* be controlled.

The problem in applying that is that the argument rests on at least three premises, and at least two of them are still open to serious debate about their validity. It seems pretty clear that there's *some* validity to the meme model, at least as a qualitative analogy, but it's a long way from being a true predictive science. Nobody can, at least yet, predict with anything like certainty which memes will spread, or which will be harmful. In many cases we can't even get people to agree on what "harmful" *means*.

But most of us *can* agree to some extent. Few would argue that high school massacres, or anonymous e-mail threats of them, are ever desirable. There's far less agreement over the extent to which violent games or web sites cause them. It's true that many of the perpetrators have frequented such things—but a great many others have also done so, without feeling any desire to commit violence in the real world. Did those who did commit real violence do so as a result of the games or web sites, or were they drawn to both violent games and violent reality because of the kind of people they were?

Please note carefully: I am *not* advocating or defending violent games or web sites. I have no use for them myself, and no respect for those who create them. But the idea that I have the right to impose my preferences on them is a potentially dangerous meme, not to be embraced lightly. That does not mean it is never to be embraced at all; those of us who prefer not to tolerate murder do have the right to impose that preference on everybody else, because murder clearly hurts people without their consent. Censorship can be justified if and only if the memes being suppressed clearly do the same—and that has not been established.

It *has* been well established that the Internet serves as an extraordinarily fertile breeding ground for the creation, mutation, and dissemination of memes of all kinds. It's like a supersaturated Petri dish, or a eutrophic pond. Ideas can spread so easily and quickly that a

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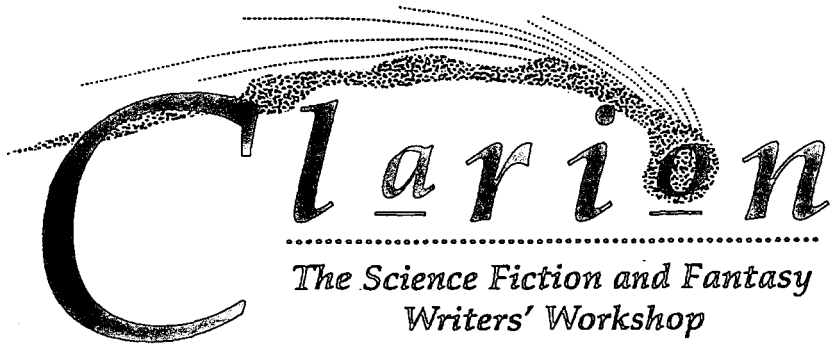

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beneficial one can develop and progress faster than it ever could have before—and a destructive or poorly thought-out one can spread far and wide before it's had much critical scrutiny or exposure to competitors.

This new phenomenon, in degree if not kind, does need to be examined and its implications carefully considered. And the need for teaching critical thinking—for everyone—is more acute than ever before. The Internet is still a wild frontier, and in many ways, for many of us, that's part of its appeal. There's an exhilaration in being able to sample such a huge number and wide variety of ideas, with so few restrictions. But ideas do lead to actions—again, that's why they're important—and when so many people are being exposed to so many, ranging from true inspiration to utter crackpottery, they need more than ever to be able to tell the difference. In fact, they need to be more than able; they need to have formed the habit of looking critically at *every* idea they're exposed to.

Most of us are, at present, a long, long way from that.

And looking critically is not enough. Important as tolerance is, in some respects most of us may need to be less tolerant. If memes evolve in much the same way as genes, and survivability is not equivalent to intrinsic quality, it is not a good idea to cheerily act as if all ideas were equally welcome. That would be like an animal or species that's fully utilizing its ecological niche welcoming another that wants to use the same resources. It may be nice and neighborly to share; it may also be suicidal. If "this town ain't big enough for the both of us" (and sometimes it really isn't), one of us will have to go. Meekly knuckling under is not a good way to survive. Memetic competition may seem different, in that the resources being competed for are not physical; but in a very real sense, memes are competing for the same territory: minds. And sometimes they are incompatible: a single mind (at least one that's functioning rationally) cannot simultaneously accommodate mutually contradictory beliefs.

So what we can justify doing, if memetic evolution is real and censorship too dangerous, is to encourage holders of ideas to promote them aggressively, actively trying to drive out competitors. I come to this conclusion with considerable reluctance, because evangelists (in the broad sense) and proselytizers can be really, really tiresome—or worse. But if bad ideas can sweep through a population for reasons that have nothing to do with their value to humanity, those who hold better ones may need to try harder to see that theirs win the evolutionary race. (A statement in which you may detect echoes of the well-known words of Edmund Burke, "All that is necessary for the triumph of evil is that good men do nothing.")

Proponents of all the other ideas will be doing the same, of course, so all this active competition of ideas has the potential for producing a rather strident environment. It also has the potential for producing a stimulating environment. And there is one important respect in which memetic evolution differs from genetic. Minds can be changed, trained, in ways that cells cannot. That implies that not all memes are equally able to infect all minds. The most infectious memes have historically depended on a strong emotional appeal that could be resisted by a mind trained to look at them rationally. In other words, the capacity for rational thought is a broad-spectrum vaccine against memetic diseases. It is therefore to our advantage to learn how to cultivate it in a much larger portion of the population than we have managed so far.

In the meantime, there's one very simple meme that could help a lot but has not been doing very well lately: Individuals are responsible, and accountable

Continued on page 28

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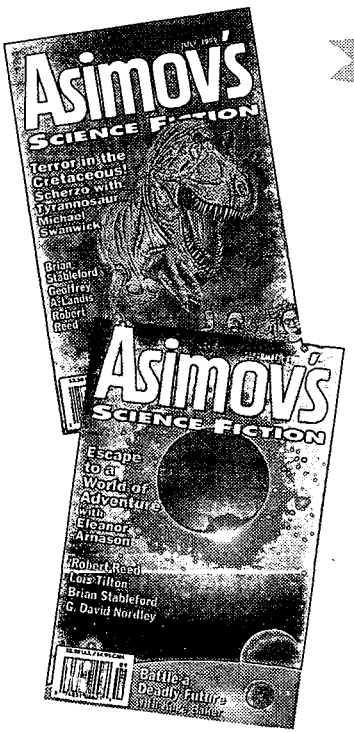

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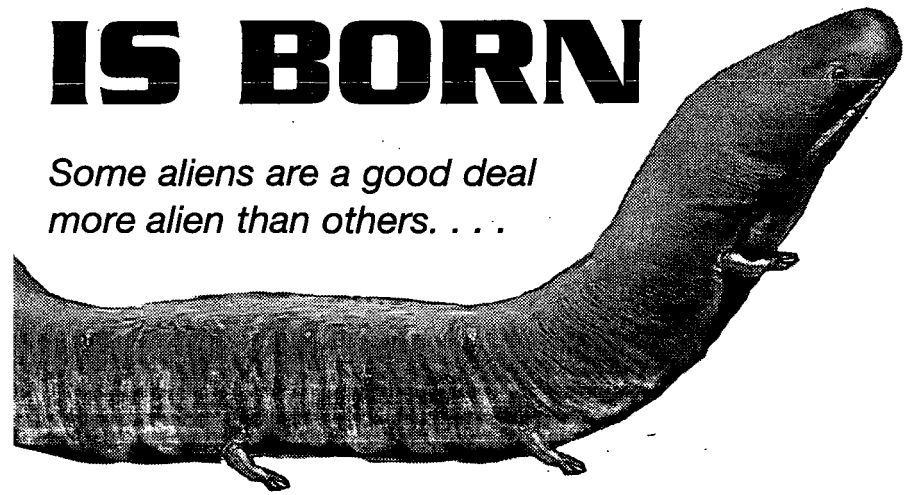
Jerry Oltion

A STAR IS BORN

Some aliens are a good deal more alien than others. . . .



When traveling with aliens, it's always a good idea to bring your own toilet paper. There's nothing more frustrating than finding yourself a thousand light-years from home without the bare necessities, so I usually tuck a few rolls in my luggage just in case.

With the Darefta I should have brought my own toilet as well. Not that it mattered to anybody but me. The rest of the crew were content to do their business wherever it was convenient, and those who even acknowledged my existence expected me to do the same.

They're not lousy hosts. The problem is they're *hosts*, in the biological sense of the word. They're huge; imagine a 150-foot snake that has eaten a whale, with six legs—the front two of which could be used for clumsy arms—sticking out beneath the lump. Creatures that big can't help but attract a following. They evolved with half a dozen smaller species who took advantage of their size and less-than-fastidious nature for a free meal ticket, so they never had to worry about cleaning up; their hangers-on were happy to do it for them. They found more and more uses for their companions as they developed higher intelligence, using them for everything from fine manipulation to an emergency food supply, but they grew so dependent on them that by the time they went into space, they had to take the whole ecosystem along for the ride. That meant a shipful of animals, not all of them housetrained or even trainable, run by a crew of seventy-ton behemoths who didn't care much where they stepped.

I could have stayed in my room—really just a packing crate tucked into a protected alcove in the ship's lifeboat—but I was here to observe the crew in action. To do that I had to mingle with them, so I wore high boots, learned to breathe through my mouth, and carried climbing gear with me wherever I went.

Illustration by Shirley Chan

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That often meant hanging out—literally—at head elevation in the nursery while my main contact among the crew, Dajef, nursed her babies. She had to do it five times a day, so she was happy to visit with me while the crew's four children slurped away at the barrel-sized nipples on her underside.

My rope sling was not the most comfortable nor the most dignified place to be, but it was by far the safest. The children, who looked like six-legged worms about twenty feet long, were omnivorous and not very choosy, so I was happy to be fifty feet above their heads. That put me in danakak territory, so I had to watch out for the aerial scavengers who fluttered around Dajef's teeth and snout, but it was better than fending for myself on the floor.

It smelled better, too, but my nose had pretty much burned out by then so that didn't matter as much as it might have. Not all of the smells were bad anyway. Dajef's milk had a gingery aroma that I actually kind of liked. It had the consistency of honey and it was bright orange, which made the children look even more ghastly than usual while they fed, but it smelled okay.

It was my fourth day on board. Dajef was telling me a joke about a Vipri, a Grath, and a Nonshweiller all stuck together on a derelict ship when the intercom clicked on with a thump like an asteroid strike and the pilot's amplified voice said, "We have reached the Inbazi nebula." What he actually said was "*Da rinoge da bara da Inbazi,*" but my earphones translated it into English for me, while incidentally muting the intercom's 150-decibel thunder to a less painful vibration that only rattled my bones.

The "*Da*" part was a meaningless noise the Dareftans all made when opening their mouths, sort of like professional videogame players back on Earth. I suppose that meant Dajef's name was actually just "Jeff," but it weirded me out to refer to something so alien by such a human name so I made sure to pronounce the "duh" part as well. She called me Darobert, so I guess it evened out.

"Fated displeasure," she said when she heard the pilot's announcement. She looked down at her distended udder. "I've still got a couple hundred gallons to go."

"It's a big nebula," I said. "We'll still be in it when you're done." She didn't need earphones; she had uploaded a translation program directly into her mind. The Dareftan ability to do that was one of the many things I wanted to understand by the time I left their ship.

"Yes," she replied, "but I won't get to see the surface structure. I wanted to examine how starlight sculpts the outer edges."

"Won't that be recorded?"

"It's not the same as seeing it with my own eyes."

Dangling as I was like a spider from the ceiling just for the privilege of watching alien rearing habits, I could only agree. "How important is the outer edge to what you're studying?" I asked. "I thought we were here to watch a protostar ignite."

"We are. But who knows what will prove to be important? That's the nature of research. I observe everything, and with luck and enough data it will all eventually make sense."

Spoken like a true optimist, I thought, but I didn't say that. I was counting on the same thing.

The Darefta were studying stellar evolution. I was studying Dareftan evolution, and I planned to tag along and watch them in action for a few weeks as they flew from star to star. A spaceship is a perfect microcosm for examining an ecosystem in detail; it's a closed environment, so unless everyone dies for lack of some vital nutrient you can be reasonably assured that everything important to survival is on board. Also, you don't have to put radio collars on your subjects and you don't have to add more variables as new species migrate in with

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the changes of season. Most of my work had already been done for me by the Darefta themselves when they'd chosen what to bring with them; my job was really just to catalogue it all and see how it interacted.

A lot of people back home thought it was a total waste of time. Why study a bunch of alien dinosaurs, anyway? Especially when there were other alien species so much closer to the human model. I had to answer that question a lot while I was applying for financial support, and I told everyone who asked it that the more we learned about species interaction in general, the more we would know about our own selves when we finally killed off everything on Earth and had to patch the ecosystem back together artificially. We thought we knew how ecosystems worked, but studying only terrestrial models was a little like expecting to learn quantum physics by studying only leptons. The Darefta were my hadrons; if they also followed the rules as we understood them, then we would know we were on the right track.

That was my official reason. My real reason was much more personal. Nobody had ever ridden with the Darefta before, and I thought it might be fun. I kept telling myself that as I dodged leviathans in the corridors and scraped dung off my boots. It was supposed to be fun.

My invitation had come about because of an argument Dajef and I had gotten into about evolution back on Tennerif station. She had promised to show me proof that evolution didn't affect some of the biggest lifeforms in the galaxy, but she had refused to tell me more, saying I would never believe her until I saw it with my own eyes. I had assumed she was talking about her own species, but so far I had found no contradictions.

Dajef was neither male nor female in the usual sense, but that didn't disprove anything. My translator called her a "trimom," apparently cobbling together the closest words it could find to match the concept. Her genetic contribution to the children was transferred through her milk in an ongoing viral infection that slowly replaced the biological parents' genes—the other crewmembers'—with her own as long as she continued to let the babies nurse. It made perfect sense, evolutionarily speaking, because the more she nurtured them, the more of her own genes they would carry.

She complained about the inconvenience just the same. She was the chief astronomer, and there she was stuck inside a mud-encrusted brood chamber half the time with nothing to do but suckle babies and talk to a foreigner who hung from the ceiling on a rope beside her ear.

The ship shuddered as we punched through a particularly thick part of the nebula. "So," I said, "What do you expect to learn once we get to the protostar?"

"I think my translation program must have a bug in it," she said. "It asked me to tell you what I didn't know."

I laughed. "It was pretty close. I asked what you're looking for. What kind of information can you get here that you can't get anywhere else?"

"Dah. I see." She turned her head, looking at me first with one eye, then the other. "I had thought to make it a surprise, but I suppose I can tell you now. We hope to contact the stellar mind at the moment of its birth, to steer its development, and to record it before it dies."

I tried not to let my mouth hang open. There were too many dazazies—little wormlike flies—around. "The stellar mind? You think stars are alive?"

"I know they are. The magnetic fields within the protostar grow incredibly complex as it collapses. I have already proven in simulations that they can achieve consciousness, but that condition only lasts for a few days before the nuclear ignition in the core wipes it out

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again. I have developed a network of probes that will let me record the state of the magnetic field before that moment, and then I should be able to replace my simulation with the real thing. I will learn to talk with it, and later I will download its mind into future protostars so I can communicate with them, too, in the short time they are alive."

She wanted to catch a star in a bottle. I wondered if she thought on such a large scale because she was so big herself, or if she was ambitious even by Dareftan standards.

I also wondered how close this meant we would be to the star when it ignited. I had assumed we would stand off a few light-hours at least, but it sounded like we would need to be closer than that to make our recording in real-time. Much closer. "How, uh, how dangerous is this?" I asked.

"Define dangerous," she said. "Our ship is designed to withstand the heat and radiation near the stellar surface. We will only be there a few hours at most. Even if that time coincides with the moment of nuclear ignition in the core, the actual shock wave takes years to propagate to the surface. We will be long gone before that happens."

I relaxed a bit. I had imagined the ignition to be like a small nova.

She belched, setting off a flurry of danakaks and dazazies around her mouth. "On the other hand, we will be skimming the surface of a star. If something goes wrong, we will probably die."

I tried to keep my voice calm. "What are the odds?"

She snapped at a danakak who strayed too close to her left eye. "Who knows? Nobody has ever done this before. Probably worse than half, though."

"Worse than half! Why didn't you tell me that back on Tennerel station?"

"I thought I did."

"You said, 'Come watch us in action if you'd like. It'll be a life-expanding experience.' You didn't tell me I might be expanding as part of a plasma cloud. And you've got children on board. What was I supposed to think?"

She snaked her tiny head—tiny only in proportion to her body—around so she was facing me straight on when she said, "What difference do children make?"

I felt the hair stand up on the back of my neck at the sight of her cavernous mouth so close to me, but it would have been standing up anyway at the news that our lives were in danger. "They could be killed, that's what difference. It's reckless endangerment, and furthermore, it makes no evolutionary sense."

"Da, evolution again. Are you still clinging to that theory? I grant it may explain the actions of primitive creatures, but not those of a being capable of directing its own behavior."

"Of course it does."

"Da, da, da. Despite the many contradictions you have observed on board?"

"There are no contradictions," I told her. "Everything I've seen so far can be explained once I learn the whole picture."

"Even reckless endangerment of our children?"

"Maybe," I said. Anger made me add, "Then again, maybe you're just insane."

She made a cat-purring sound deep in her long, sinuous throat that vibrated the walls, and my teeth. Laughter. "I am probably that. After all, I'm the one who believes she can talk to a star."

I looked at the nursery around me. Three hundred feet across, with mud walls dripping from condensation. A couple feet of dung mashed underfoot, mixed with hay the size of bamboo stalks and crawling with "darats" and "daspiders" and "dabeetles" the size of coyotes. The place stank like a cattle dome. On the other hand, Dajef may have had the appearance of a clumsy, six-legged mountain of flesh, but the three-foot squids she called "dabaras" that hung like tentacled remoras from her flanks were remote-controlled

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hands, programmed before their release by a brain the size of an elephant in the forward part of that immense body. There was plenty of gray matter left for abstract thought. That didn't guarantee sanity, but I didn't think she was suicidal, either.

She was merely adventurous. Just my luck. I had figured my worst danger on board the Dareftan ship would be from clumsy leviathan feet, not from their careless sense of derring-do.

"Do you want to leave?" she asked. "You could take the lifeboat now and wait for us outside the nebula."

The expedition ship was nearly half a mile long, and shaped like a blunt teardrop. About halfway down its curved topside, a lifeboat bigger than most human-built starships stuck like a tick on a dog's back. It was my temporary home while I was on board, and I actually thought about fleeing in it while I had the chance, but not for long. "Oh, sure," I said, "and strand you on the surface of a collapsing star with no chance of escape if something goes wrong."

"Was that a yes or a no?" she asked.

Translation problem again. Never trust language software to do your thinking for you, even if it's part of your brain.

"That was a no," I snapped. "If I lived and you died, I'd feel guilty the rest of my life."

"You prefer death to guilt? Yet you continue to believe in evolution?"

"It's not that simple," I said. I took a deep breath, trying to calm down. "If I *knew* we'd die in there, I'd take the lifeboat in an instant. But since there's a possibility we'll all survive it, maybe in that same lifeboat, I can't lower your chances just to increase mine. That's—well, I guess that's called honor. It's a long-term survival trait. Benefits the race rather than the individual."

"I fail to see how."

"It increases the status of my offspring," I said. "That improves their chances for reproductive success, so the race gets more copies of the genes that make people help each other in an emergency."

"I thought you had no offspring."

"I don't," I said. "But if I did—"

"Evolution makes such theoretical leaps? I am making a pretense of being impressed."

Was that the translator again, or had she made a joke? I didn't know, and I wasn't in the mood to pursue it. Neither was she, apparently. She rolled to her feet, pushing her young ones aside so she wouldn't step on them, and said, "I must go ready the magnetic sensors."

"You do that," I replied, looking down to where the children squalled and snarled at each other, their orange-stained mouths and pointed fangs matching my mood. One of them looked up at me, then stretched to its full length, trying to reach me. Just like any child, it wanted to touch everything it saw. It probably wanted to put everything in its mouth, too. I shivered and reeled myself closer to the ceiling, but I wondered why I didn't just do a swan dive into their midst instead. What difference did it make if I was vaporized in a star or eaten by a twenty-foot grub and then vaporized in a star? Dead was dead.

The cavernous door irised open to let Dajef out. My path back to my room or wherever I wanted to go would be through the air duct overhead, but I didn't crawl through the grate just yet. As long as I was there, I might as well watch the children play now that they had been fed. It seemed stupid to just continue on with my research while the ship plowed deeper and deeper into trouble, but it would be even more stupid to go sulk in the domesticated packing crate I called a stateroom and wait for the end. If we didn't go up in flames, I would look pretty foolish.

The young ones were just starting to develop the swelling in the middle of their bodies that would become the digestive system and muscle mass they would need to support a heavier body. It

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wasn't yet big enough to keep them on all sixes, especially in the half-gravity the Darefta maintained on board. They could still rear up on their coiled tails and reach for me, and when they grew bored with that they dropped on each other, the solid meaty *smacks* and their happy squeals echoing in the brood chamber. They tumbled together into one big, writhing heap, tugging on each other's heads and biting each other's tails like kittens.

How could rational parents expose their offspring to a worse-than-even chance of death? Even if Dajef was crazy, each of the kids had two other parents among the crew. They couldn't all be nuts. There had to be some advantage I wasn't seeing, some potential gain that made the risk worth taking. Maybe it was the same as my own reason for not taking the lifeboat. If we succeeded in recording the mind of a star and returned home with the evidence, everyone on board would be instantly famous. In Dareftan society, that might be worth the risk.

Hell, it might be worth it in mine. I smiled grimly at the thought. If I lived through this, I could come out of it smelling like a rose. After I took a week-long shower.

We came to a stop a quarter million miles from the surface of the protostar. It looked pretty much like a regular star to me, glowing bright yellow and surrounded by a wispy white corona. That corona was gas falling *in*, however, not blowing outward, and all the light was from frictional heating as the star contracted. The neutrino flux was still negligible, though it spiked occasionally as small pockets of hydrogen at the core went critical.

The nebula from which the star had formed was still drawn tight like a blanket around it. The inner surface was deep violet and bumpy, roiled like the underside of a thundercloud.

"Is that caused by turbulence or light pressure or what?" I asked. I was standing on the control console, up near the top edge where I had a good view out the forward window and where I wouldn't get squashed if the pilot, Dalapek, started pushing buttons in a hurry.

"Yes to all three," Dajef said without looking away from her monitors. She stood off to the right, also facing the window, but with a curved theater of holo tanks surrounding her on the other three sides. From my angle she was just a shadow behind a ghostly line drawing of the magnetic field lines, which were winding tighter and tighter as the star gained rotational speed from infalling matter.

Two of the other crewmembers were running the probe guidance controls and the computer that would collect the incoming data. The rest were in the cargo bays, waiting to start feeding probes into the launch tubes when Dajef gave the word.

"What's the 'or what' part?" I asked.

"Magnetic effects. Gravity. Planets are forming out there. Some of them might even be habitable in a billion years or so, if the star chooses the right evolutionary path."

"Say what?" I asked. "Evolution? I thought you didn't believe in that."

"Translation glitch," she replied. "Apparently you use the same word for two different things. To me, stellar evolution means what happens to an individual star over its own lifetime. I'm talking about the decision to flare early and drive off the rest of the nebula with light pressure so it becomes a smaller, more steady-burning star, or to hold off as long as possible and collect as much mass as it can, which will ultimately shorten its life or even turn it into a variable."

"You talk like the star has a choice. I thought the density of the gas cloud determined that sort of thing."

"Largely, yes. But the last-minute infall is significant. The moment of ignition determines everything from stellar com-

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position to planetary formation, and that moment happens while the star is alive."

"Provided your magnetic plasma brain theory is true," I said. "But even if the star is awake, that doesn't mean it has a choice, or the ability to do anything about it anyway."

"It does. It just doesn't realize it. That's why I'm trying to learn how to communicate with them."

One of the monitors flickered and went out. Dajef growled, and my translator said, "Typically perverse." She yanked one of her squidlike dabaras loose from her flank and shoved it through an access hatch, then continued working at the controls for the magnetic field probes.

"What do you mean, that's why you want to talk with them?" I asked. "You want to coax them into holding on?"

"No," she said. "I want to ask them to commit suicide." She stuck her head through the hologram between us to look at me. "The sooner they ignite, the more steadily they burn. The more steadily they burn, the more conducive their planets will be to life. I plan to ask them for a favor. But to do that, I have to learn how to talk to them."

I didn't know what to say. Did she really think she could talk a being who only lived for a few days into killing itself early so someone could get a tan under its light a billion years hence? What difference would that make to the star? Why should it care?

I almost started that argument, but the dead monitor came back on and Dajef got busy at the controls below it. She slapped an intercom button the size of a dinner plate and said, "Begin launching."

I could feel the faintest of vibrations as the probes blew free. There were just over a thousand of them, each the size of a railroad car. The optical monitor showed their paths as they accelerated away to surround the star and skim along just above its surface.

We weren't so far away from it ourselves. "What's our hull temperature?" I asked.

She had to ask Dalapek, the pilot, but my earphones translated his reply directly: "Three thousand degrees."

"How, uh, how dangerous is that?"

"Don't touch it," Dajef said.

"Duh," I replied, but she didn't respond. Of course not.

The ship's hull had been designed to burn away slowly and carry off built-up heat as it did, but there was a limit to what it could withstand. And how long.

I retraced the path to the lifeboat in my mind. Back along the central corridor, jog left toward the nursery, then up to the outer hull. It would be in the main ship's shadow, so it should be relatively cool until it cast off, after which its underside would start to heat just as badly in the intense light this close to the protostar. It would actually heat worse, because the lifeboat's hull wasn't built to ablate nor shaped to deflect intense light. It had a concave underside designed to conform to the main ship's round surface, plus engine ports and access hatches and leglike instrument housings all along its length. If it was exposed to the protostar for more than a few minutes, it would vaporize. But we wouldn't stay close to the star if we needed the lifeboat. The moment we launched it, we would be fleeing for our lives.

Dajef's dabara popped out of the access panel and slithered back to her side. Dajef paid it no attention. She was focusing on the magnetic field display, which was knotting up like a ball of string in a blender. The level of detail grew finer and finer as the probes started reporting in, and I could see how it continued its fine structure as small as my eyes could resolve it, like a fractal.

"It's getting complex," she said. "It could become self-aware at any moment."

"How will you know?"

"Watch."

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"We'll be able to *see* it?"

"If it follows the simulations."

I watched, looking from the magnetic field display to the window, where the surface of the star curved gently away from us, the nebula like a mottled stage curtain behind it. The stellar surface was beginning to swirl and flare as the magnetic fields dragged huge volumes of charged plasma around in their embrace.

"There it goes!" Dajef shouted. I covered my ears a second too late, but I looked back to the monitors. The optical ones didn't show much, but the magnetic image suddenly locked into place, then began to vibrate with a million tiny waves that propagated back and forth through it. They built up and flattened out in three-dimensional interference patterns that looked way too regular to be accidental.

"Holy shit," I said. Those looked like brain waves.

"Yes," Dajef said. "It is a pitifully low-resolution map. I would need millions of probes to gather every nuance of the star's mind. But with luck, it will be good enough to retain its intelligence in a simulator."

"That's—" *not what I meant,* I started to say, but I stopped when I saw the lines of force shift again. They reached upward like amoebae, little loops peeling off and reaching still farther, clear up to the surface.

"It senses the probes!" Dajef said.

"Probes, hell, it senses *us!*" I yelled, because I could see the side of the hologram she couldn't, and one of the magnetic loops—the one pointing straight at our ship—didn't stop at the surface.

Out the window huge flares arched out from the photosphere, following the field lines. The magnetic map lost resolution as the probes failed one after another.

"Get us out of here!" I shouted at Dalapek. He couldn't understand me, but he didn't need to. He could see the obvious just as well as I could. Like any newborn child, the star was reaching out to touch the only thing it could feel, using the only sense and the only appendages it had available: magnetism. It probably didn't even know that it was trailing million-mile-long limbs of superheated plasma behind it, or what it would do to us if it touched us. It probably didn't know anything at all, except that it existed, and something else did too.

Dalapek mashed a big yellow button under his three-fingered hand. The ship lurched as the artificial gravity fought to cancel the forward thrust, then lurched again when the magnetic field swept through us.

I had never actually seen a control panel erupt in a shower of sparks before. Vids show it happening all the time, but it's usually a load of hooey. Impacts don't cause voltage surges. On the other hand, magnetic fields certainly do, especially ones strong enough to drag a solar flare along after them. The control panel became a very bad place to be just then; at the first sign of trouble I took a running leap and jumped the ten feet of space to Dalapek's forearm while fireballs blew through the plastic buttons right behind me. I pulled myself upward until I was closer to his body, then grabbed hold of his rubbery skin with both hands.

He reached forward to do something; switch off the power, run the throttles up to full, I'll never know. His head and forearm were right over the panel when it exploded upward like a bomb had gone off inside it, and the impact knocked him backward hard enough to lift him off the deck.

It also flung me upward, arcing through the holographic display that tracked our destruction. I felt a moment's hilarity at the realization that it was the star's life, not my own, that flashed before my eyes in my final moments; then I hit Dajef's side, bounced off, fell about twenty feet, and lurched to a stop with my head just a couple of

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feet off the floor. One of her dabaras had snagged me by my right foot.

"Thanks," I managed to croak. It looked at me with three or four of its multiple eyes, blinked one of them, and stretched its tentacle to lower me to the floor.

I promptly ducked for cover under the holo tank, because Dajef was jerking around like a fish on the end of a tight line. She'd gotten hit by some high voltage.

A major quake shook the floor, and by the wet, heavy thud that accompanied it I guessed that Dalapek had fallen. By the looks of his head as I'd flown past it, I didn't think he'd be getting up again.

The star was still reaching for us, dragging its magnetic field back through the ship. The lights flared bright as sunlight for a second, and the gravity suddenly tripled. I sagged to the floor, but Dajef did worse than that; I heard bones break and saw her body flatten out like a water balloon just before it bursts.

The generators failed before she did. She rebounded toward the ceiling, and I heard her scream when she hit it head first.

Then the lights blew out. The control room didn't go dark; there was plenty of the real thing just outside, and the forward window was a real window rather than a viewscreen.

It was also melting. It was an ablative insulator like the rest of the hull, but at least half of it had already vaporized. I could see it bubbling just a foot or so from the inner surface.

"Time to go!" I yelled. I pulled myself out from under the holo tank and shoved my way up the side of it, grabbing the lip to pull myself to a stop. "Dajef!" I shouted. "Dajef!" She was a blimp overhead, adrift.

She quit screaming, but she didn't answer me. I doubted if she'd heard me over her own voice anyway, so I yelled again, "We've got to get to the lifeboat!"

"I'm . . . injured," she said. Her voice was barely a whisper. The only reason I could hear her was because there weren't any other noises in the control room at all. The ship was dead.

So were her other crewmates. They hadn't been as lucky as she was when the gravity generators had overloaded.

"Can you move?" I asked, kicking off and floating up toward her head.

She tried, screamed again. "No! Save yourself. Go."

I thought about dragging her through the ship. We were in free-fall, after all. Once I got her moving, it wouldn't matter how big she was.

There was the rub, though. Getting her moving would take half an hour, and stopping her at the other end of the corridor would take just as long. Not to mention the two turns on the way. We had maybe five minutes before the window weakened enough to blow out. Less if the star tried to touch us again.

I grasped the side of her neck and looked back toward the doorway, thanking luck it had been open when the power failed.

"Save the data," Dajef whispered. A dabara wriggled free, jumped to the computer, and disappeared inside. A moment later it reappeared and launched itself carefully toward me. I flinched away, but it reached out with a tentacle and snagged my leg, then slithered up to grip me around the waist. I saw no memory cards in its grip. Had it downloaded the star's mind into its own?

"Data schmata," I said. "What about the children?"

"You . . . would risk your life for . . . an alien's offspring?"

"If I knew how to get them into the lander."

She thought about it. "They wouldn't listen to you. Forget them. Save yourself."

"I can't just leave you—"

The window started to squeal. With a cry of pure agony, Dajef flicked her neck like a whip, throwing me straight through the doorway. I sailed past the

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portal with dozens of feet to spare on all sides and continued on down the corridor at about fifty miles an hour, wondering how I was going to stop, but the window solved that problem for me. It blew out while I was halfway down to the end. Air roared past, pelting me with debris I didn't even want to think about, but it slowed my flight to practically nothing before the corridor suddenly got very dark and the wind cut off. I twisted around to see if the pressure door had closed, but it was still wide open.

Dajef's body was wedged in the window. Air still whistled out around the edges, and sunlight still leaked in, but the worst of the hole was plugged. I had no idea how long that would last, but I didn't wait to find out. I hit the end of the corridor feet-first, took two running steps to the left and kicked hard for the side corridor before I bounced away. My balance was off with the dabara on my back, but it helped steady us with its tentacles.

This corridor was short, less than a hundred yards. At the end of it, the nursery door was sealed tight. Straight up, in a shaft that never had gravity generators to begin with, was the direct access tube to the lifeboat. The circular doorway up there was wide open, and soft light glowed from beyond it. The boat had its own power supply, and the bulk of the starship had spared it the worst of the flare's effects.

I wanted nothing more than to jump into that light, but the nursery was right there. I had to at least try. I braced myself against the jamb and pounded on the "open" button with my fist. It was at least a foot across and spring-loaded for giants, but it slid into the wall for a second before popping back out.

Nothing happened. I hit it again, making sure it bottomed out against the contacts this time, but still nothing. The door had no power.

There had to be a way to open it manually. I leaned back, careful not to lose my grip on the jamb, and looked for it. It was easy to spot: a crank overhead with a shaft as big around as my thigh. I wasn't going to get that door open anytime soon.

I tried it anyway, jumping up and grabbing it in my hands, then planting my feet against the ceiling and shoving. It didn't budge, so I tried to tug it the other way, but of course I had nothing to hold onto, so I just managed to pull myself toward the crank.

Then the dabara slid around and stuck half its tentacles to the ceiling, and pulled on the crank with the other. It turned smoothly, and the door irised open a few feet. When the dabara got the crank around so I could push, I helped it along, letting it tug the handle around again.

We had opened the door about halfway when I suddenly realized it was big enough. One of the children stuck its head out of the hole in the middle, coming straight at me with a toothy mouth about five feet across.

I yelled "Yaaa!" and kicked off toward the lifeboat. I didn't have to tell the children to follow me. As soon as they saw me, they all swarmed out into the corridor, trailing a cloud of debris behind them. They'd have had me at first leap if they'd had any experience with free-fall, but they were even more clumsy at it than me. The dabara landed on my back again and with its help I managed to stay ahead of them all the way up the corridor, and I ducked to the side just inside the door.

They went roaring past like shuttles late for dock. I climbed up the curved frame and slapped the door-close button while they were still nosing around the controls, then yelled "Hey, over here!" and waited until they were airborne again before I jumped over their heads and bounced off the ceiling toward the forward window. I risked a glance outside; we were still in the shadow of the main ship, but huge flares arched overhead and ionized gas streamed upward

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around all sides, glowing like liquid neon light. That was our hull boiling away.

My packing crate home was tied to a girder just above the door. I'd put it there so it would be out of the way in case of an emergency. Its open doorway offered familiar sanctuary, but I couldn't go for it yet.

There was one big yellow button in the middle of the control panel. I hoped to hell that was the "go" button, and that the autopilot was smart enough to fly us out of here on its own, because that was the only chance I was going to get. I took aim, leaped for it, kicked it with both feet, and let the rebound send me back to the ceiling again. One of the children clipped my heel with its outstretched hand as it tried to intercept me, but I kept going, tumbling end over end until I hit one of the open girders on the ceiling. I kicked off for my crate just as the autopilot said "Prepare for boost," but I made it through the doorway and grabbed my zero-*g* sleeping net for support, then peered cautiously outside.

There were vertical panels rising from the floor behind the control console. Back rests, I guessed, which meant there wasn't any artificial gravity in here even during boost, and the direction of thrust would be from behind. I clung to my net and waited for it to hit. The dabara looped a couple of tentacles around the net and a couple around me as well.

Two of the children leaped toward us.

"Launch!" I screamed.

Nothing happened. I ducked inside just as they hit. The plastic crate was designed to take a beating, but not an assault; one side caved in and a big split popped open right beside my feet. The door was too narrow for the children to stick their heads through, but it wouldn't take them long to try reaching in with their hands.

I looked wildly around for a weapon, but there was only my duffel bag and some of my personal junk held in place behind another drift net. Nothing there would even slow down a Dareftan child, but I started throwing things at them anyway, determined not to give up without a fight. Data disks, my book reader, my razor—I threw practically everything I owned at them, including a roll of toilet paper which bounced off one of the children's nose and caromed away, spilling a long fluttering tail out behind it as it unrolled.

The crate rocked as both kids shoved off after the bright white streamer. A second later the lifeboat shuddered as the docking clamps released, then a gentle push shoved me against the back wall. The door was right in front of me; I stuck my head out and watched the flying mouths drop back to the floor to land among their siblings.

The thrust built up to a full *g* and then some as we streaked away from the melting starship. The deep violet nebula reached toward us like a flat wall, and I gasped as we plowed into it with a shudder and a groan from the hull. The sunlight grew dimmer, then faded out entirely when the overdrive kicked in. I had no idea where it was taking us, but wherever it was had to be better than here.

The dabara on my back wriggled free and dropped down into the tangle of children, who were voicing their frustration at being pinned to the deck while I dangled out of reach overhead. The dabara attached itself to the topmost one, which shivered as if it had been bitten. The baby Dareftan looked up and squeaked at me, and I was surprised when my translator said, "Who are you?"

"Dajef?" I asked. Could she have downloaded her own personality into the dabara? Or was this the star's mind overlaid on the Dareftan child's? Their brains were programmable, after all.

"Dajef?" it echoed. Apparently the name wasn't familiar. That meant I was talking to a star. A star in a baby's mind. I

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wondered if that's why Dajef had brought children along.

"Dajef is your trimom's name," I told the gestalt being below me. "And your savior's. And maybe your jailer's and your executioner's as well, depending on how things turn out." I didn't know if it had the translation software it needed to understand me, but I thought maybe the sound of a voice might be soothing.

It looked at the window, then back at me, clearly puzzled by this sudden odd turn of events.

So was I. Why had I risked my life to rescue these children? For that matter, I was still risking it. There were undoubtedly rations on board for Dareftan passengers, but I could easily end up as a snack if I wasn't careful.

"It was the least I could do," I said, more to myself than to the child. "She was trying to make livable solar systems for people a billion years in the future. I couldn't let genes like that go to waste."

It occurred to me that I was living proof of Dajef's argument that rational beings could think themselves into counterevolutionary strategies. I had put an abstract higher cause above my own safety, just as she was hoping to someday convince stars to do. I hadn't consciously intended it, but that's what I had done. Which meant, I supposed, that convincing a star to do the same might not be so difficult after all.

I looked out the window at the darkness. There were hundreds of protostars in this nebula alone, all of which could become life-supporting solar systems for our descendants. Maybe even some of my own, if I survived to have any.

I looked back inside my crate, taking inventory of what I had left. Plenty of food. Extra clothing. And two more rolls of toilet paper, which might just come in handy before we got back to civilization.

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Ben Bova

SLOWBOAT TO THE STARS!

Solutions to problems may come from unexpected directions.

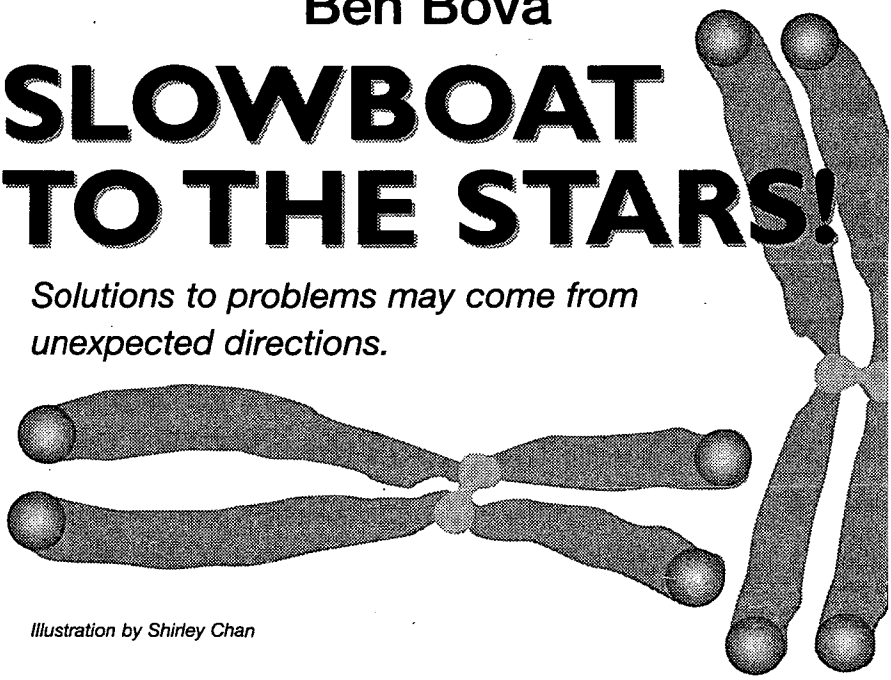

Illustration by Shirley Chan

On to the stars!

Since 1905, when Einstein pointed out that nothing in the Universe can move faster than light, physicists and science-fiction writers have been racking their brains trying to figure out a way get around the light-speed limit.

The way has been found. Not by the physicists. Not even by the science-fiction writers.

By the biologists.

Don't raise the bridge, lower the river

If you can't get up to warp speed, take the slow boat. To paraphrase *Star Trek*'s Mr. Spock, "Live long and forget about FTL."

The search for a way to go faster than light has been based on the fact that the stars are so damnably far apart. Even if you could fly at light speed (186,000 miles per second), it would take more than four years just to get to nearby Alpha Centauri, a thousand years to reach Polaris, and 30,000 years to journey to the center of the Milky Way galaxy.

Far too long for our pitifully short human lifespans, obviously.

Until now.

In the past few years, breakthroughs in biological research have shown promise that human lifespans may be extended to hundreds or even thousands of years. Physical immortality may well be within sight.

The old idea that human lifetimes are limited to roughly "three score years and ten" is about to be demolished. The first immortal humans are probably living among us today. You might be one of them.

And you won't age. You won't grow progressively more decrepit as the years slip by. In fact, aging itself may be reversible—a happy thought for those in the latter stages of their youth, as I am.

There are samples of human cells in laboratories that have lived much be-

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yond their normal lifespans. Some biologists believe that it will soon be possible to allow people to live to 200 or 300 years. By the time you're 250, of course, so much more will have been learned that your lifespan might well be extended indefinitely.

Physical immortality. It won't be an unmixed blessing, of course. Our ideas about Social Security and pensions in general will have to be drastically overhauled. Marriage, law, social customs of all sorts will change radically. Population pressure will inexorably mount when the death rate goes down close to zero, unless we learn how to bring the birth rate down equally far.

But immortality puts the stars within reach. You can cruise out to the ends of the Universe within Einstein's speed limit because you will be able to live as long as you please and remain youthful as long as you live.

Long Lives

That "three score and ten" line comes from the Ninetieth Psalm, a prayer that the Bible attributes to Moses:

> *The days of our years are threescore years and ten; and if by reason of strength they be fourscore years, yet is their strength labor and sorrow; for it is soon cut off, and we fly away.*

Thus the concept that a human being's "natural" lifespan is at best somewhere between seventy and eighty years has been with us for a long time.

Yet Moses himself, according to the Bible, lived to be 120. Modern scholars do not accept that figure, but vastly elongated lifespans dot the Old Testament. Methuselah's age is given as 969 years; Noah's, 950.

The chances are that those numbers actually refer to months, not years. That would make Methuselah almost 81, Noah slightly more than 79. Still, in an age when most people did not live to see 30, those were remarkable lifespans.

The oldest human being whose age is reliably recorded was Jeanne Louise Calment of Arles, France, who was born 21 February 1875 (14 years before the Eiffel Tower was opened) and died 4 August 1997 at the age of 122 years, five months, and 14 days. She remembered selling pencils to a struggling young artist named Vincent Van Gogh.

Is there a natural limit to human lifespan? Is there something built into our bodies, into our genes, that prevents us from living indefinitely?

If there is, can modern science find ways to break through this natural limit?

The answers seem to be: Yes, yes—and yes.

Immortality and the Hayflick limit

In the 1970s the American cellular biologist Leonard Hayflick discovered that most types of human cells have a natural limit to the number of times they can divide, or reproduce.

Some types of cells, such as those that produce red and white blood corpuscles, can divide millions of times. Others, such as most nerve cells, do not reproduce at all. If a cell's Hayflick limit is 50, for example, it will divide 50 times and then become senescent. It withers and dies.

As large numbers of cells die off, we get the symptoms of aging: our joints stiffen, our muscles lose strength, skin wrinkles, eyesight fades.

When enough of our cells die, we die.

Yet some cells have no Hayflick limit. Barring trauma from outside, they are immortal. They can be killed, but they do not age.

The "lowly" bacteria are immortal. They can be killed—by starvation, radiation, lack of water, or being eaten by another organism. But they do not age. Bacteria keep on dividing forever, until some outside agency kills them.

Cancer cells are similarly immortal. They keep on dividing and dividing, endlessly, unless they are killed or their host dies. "HeLa" cells, taken from the tumor of Henrietta Lacks before she

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died in 1951, are still reproducing as vigorously today as they did nearly 50 years ago.

Human germ-line cells—ova and sperm cells—also show no Hayflick limit.

Why can some cells keep on going and going like the pink bunny in the TV commercials, while others curl up and die after a certain number of divisions?

Telomeres

Some biogerentologists (scientists who study aging) believe the answer lies in our *telomeres*.

Inside the nucleus of every cell in your body are the long strands or filaments called chromosomes. Human cells have forty-six chromosomes, except for the sex cells, which have half that number. The chromosomes contain DNA. And DNA makes up the cell's genes.

At the tip of each spindle-shaped chromosome is a sort of cap, called a *telomere*. Telomeres somewhat resemble the aglets on the ends of shoelaces. The telomeres keep the ends of the chromosomes from sticking together, and from sticking onto other chromosomes. Bacterial DNA does not have telomere caps, and tends to loop itself into a ragged circle, like a snake swallowing its tail.

Telomeres keep the individual strands of DNA in our cells from looping or connecting to one another. They also play an intriguing role in cellular aging. Some researchers believe that telomeres are a sort of cellular clock that sets the rate at which the cells age and eventually die.

Each time a cell divides, its telomeres shorten. When the telomeres become short enough, cell division stops and the cell soon dies. But cancer cells regrow their telomeres after every division.

Michael Fossel, professor of clinical medicine at Michigan State University, says quite clearly, "Telomeres [are] the clocks of aging." He and other researchers believe that telomere shortening is responsible for cellular aging and, eventually, cellular death.

Most biologists do not accept so simple an explanation. And yet . . .

Telomerase

In January 1998 researchers announced that they had extended the lifespan of human cells "indefinitely" in a laboratory experiment in which telomerase was added to the cells.

Telomerase is the enzyme that essentially builds new telomeres. Cancer cells produce plentiful telomerase. Normal human cells do not—even though they have the telomerase gene in their DNA. In normal human cells, that gene is suppressed, deactivated.

The researchers, from Geron Corporation and the University of Texas Southwest Medical Center, inserted an activated telomerase gene into the cells. The cells reproduced well past their Hayflick limits, giving powerful evidence that telomeres have a decisive influence on cellular senescence and may indeed be "the clock of aging."

Writing in the prestigious journal *Science*, biologist Titia de Lange, of Rockefeller University's Laboratory for Cell Biology and Genetics, commented, "The doubt [about telomeric influence on aging] has now come to an end with a report . . . describing direct evidence for a causal relation between telomere shortening and cellular senescence."

Telomerase and cancer

Many researchers are interested in finding how to prevent cancer cells from producing telomerase. If a telomerase "off" switch could be found, it will become possible to stop tumors before they grow large enough to be trouble.

The fact that normal cells possess the telomerase gene but do not employ it may be a warning signal. Activate that gene and the cell may start runaway cancerous growth.

The goal, then, is to control telomerase production well enough to re-

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move the cell's Hayflick limit and allow the cell's owner—maybe you!—to live forever. Without causing cancer.

MORF4

Meanwhile, researchers at Baylor College of Medicine in Houston have cloned a gene that makes some types of human cells live more than twice as long as they would normally.

It may also cure cancer.

When added to cancerous cells, the *MORF4* gene (MORtality Factor from human chromosome number 4) stops the cells from reproducing. The tumor stops growing and becomes senescent. A mutated form of *MORF4*, when added to normal human cells, allows them to keep on reproducing far beyond the normal limits of their lifespans.

Another road to immortality? Don't bet against it.

Human growth hormone

One protein that seems to have a measurable effect in extending lifespan is human growth hormone (hGH), also known as *somatotropin*.

Human growth hormone is secreted by the pituitary, a tiny gland located at the base of the brain, not far from the pineal. The pituitary is known as the master of the endocrine system, because it regulates the secretion of hormones by the body's other ductless glands, such as the thyroid, adrenals, gonads, etc., which, in turn, secrete the hormones that regulate the body's metabolism.

Human growth hormone has many vital functions, ranging from building bones and muscles to strengthening the immune system and helping to heal wounds. Dwarfism is a consequence of lack of hGH, and abnormally small children are treated with it to help them to grow closer to normal size.

While growth hormone is secreted in large amounts by adolescents during sleep, in adulthood its production diminishes, often as much as ten to 15 percent every ten years in men. Women maintain higher levels until they reach menopause, then their hGH production rapidly declines. Researchers have not missed this obvious hint that slowdown in hGH may be related to aging.

Low levels of hGH are associated with loss of muscle leanness and accumulation of fat. Worse, as the individual's weight increases, hGH levels drop more, setting up a feedback loop. Injection of hGH improves muscle strength and leanness, apparently helping the body to build protein instead of fat.

Dr. Daniel Rudman of the Medical College of Wisconsin tested hGH's antiaging possibilities with a group of male volunteers in their 60s and 70s. Half the volunteers received no hGH injections; they were the control group. The others received hGH injections three times a week for six months, so that their hGH levels were returned to the amounts they had as young men.

While the men in the control group showed the normal deterioration of muscle, bone and organs expected for men of their age, those who received the hGH injections not only stopped aging—in some ways their aging was reversed.

They put on new muscle mass. Their skin increased in thickness by almost ten percent. Internal organs such as the spleen and liver also gained mass. Some of the deteriorative effects of aging had been stopped and even turned around.

To make certain these effects were due to hGH, the researchers stopped the injections. The "youthful" group began to age normally once again.

It is far too early to be certain, but if there is a single elixir of youth, human growth hormone might be it. Still, hGH needs to be tested over long time spans, and its possible side effects must be tracked down. It is known, for example, that overly large doses of hGH can cause or aggravate hypertension, lead to diabetes, enlarge the heart, and affect the joints.

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Regeneration

Another avenue toward greatly extending human lifespan lies in the possibilities of tissue regeneration. Within the past few years, experimenters have shown that blood vessels, internal organs, even spinal cord neurons can be regenerated by the body—with a little help from the biologists.

Once you were nothing more than a single cell, a fertilized egg.[1] Your one cell divided into two, and they divided, and divided and divided again—about fifty cycles of cell division altogether. Your cells changed as they divided. Some became muscle cells, some became nerve cells, some became skin, heart, eyes, hair, fingernails, arms, legs, and all the different parts of your body.

Now you are a smoothly functioning individual of some hundred trillion cells, all of them the offspring of that one microscopic cell that was the original you.

Each one of your cells contains all the information, in its genes, to build another copy of you. That is the basis for cloning. While moralists heatedly debate the prospects of cloning human beings, there is something much more important and valuable involved in the fact that each of your cells contains the complete genetic blueprint of all of you.

If only we could learn how to *use* that information properly, we could grow new organs, limbs, skin, muscles and any other part of the body when we need to. The problem is, however, that although each of us grew from a single cell, we lose the ability to grow new limbs and organs once our original equipment is in place.

Bioscientists say that the early zygotic cells are *totipotent*. That is, each of those cells has the capacity to differentiate into all the various types of cells of the adult, from toenails to the "little gray cells" of the brain's cerebral cortex. As the zygote grows into an embryo, its cells become more and more restricted. They are *multipotent*, which means they have the capacity to produce a large number of different kinds of cells, but not all the different kinds that the earlier totipotent cells are capable of producing.[2]

Once the embryo's cells differentiate into specific types of cells—heart, liver, nerve, bone, etc.—they lose their pluripotency. Those cells have specialized, and they will remain specialized. A muscle cell, for example, will not change into a nerve cell. The cells of the lungs will not suddenly transform themselves into red blood cells.

However, each and every cell still carries in its nuclear DNA the genetic blueprint for the entire body. All the genes reside in each cell, although once the cell has differentiated, most of its genes are turned off. Only the genes that are necessary for the cell's specialized job remain active. The rest remain dormant forever.

Unless bioscientists learn how to activate them.

Stem cells

In November 1998, research groups at Johns Hopkins and the University of Wisconsin at Madison reported that they had isolated embryonic stem cells, those totipotent cells capable of producing any kind of cells needed, from heart to hair, from toenails to cerebral cortex neurons.

The challenge now is to use stem cells to produce other types of human cells—in essence, using the stem cells as a primordial "organ bank" capable of delivering any type of human cell necessary for repairing damaged or diseased tissue.

Earlier, at the 1997 meeting of the American Heart Association, two re-

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[1] *A fertilized egg cell is called a* zygote. *As the cell divides and grows, it is referred to as an* embryo. *Once the human body form is apparent, after the third month of pregnancy, the embryo is called a* fetus.

[2] *Multipotent cells are also called* pluripotent

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search teams revealed that they had used gene therapy to coax the body to grow fresh arteries as natural bypasses for clogged blood vessels.

Scientists from St. Elizabeth's Medical Center in Boston reported that they had injected 20 patients with a laboratory-produced version of the human gene that makes a protein, *vascular endothelial growth factor*, which spurs the growth of blood vessels in human fetuses. Sixteen of the 20 patients, who suffered from severely clogged arteries in their legs, grew new arteries that carry blood around the clogged vessels. The constant pain that had afflicted them has been relieved, and they have been spared the need for leg amputations. Several of the patients have even started to grow toenails again.

The second team, from Brigham and Women's Hospital in Boston, is using similar gene therapy to make coronary bypass surgery work better.

Meanwhile, researchers at the Fulda Medical Center in Germany reported that they were able to trigger the growth of new coronary blood vessels by using a genetically engineered human growth factor, FGF-1. The growth factor was injected into 20 volunteers as they underwent conventional heart surgery. Within four days, all 20 patients began to grow new blood vessels.

By learning how to get the body to generate new blood vessels on demand, the need for bypass surgery will eventually be eliminated. Why cut blood vessels from various parts of the body and staple them into the heart's arterial system when you can get the body to grow new arteries on demand?

Also in 1998, a pair of Harvard researchers announced that they had grown entire replacement organs—including hearts, kidneys and bladders—for lab rats, rabbits and sheep. They used the animals' own cells as the starting material, grew the new organs in the laboratory, and then implanted them surgically into the animals.

The two scientists who made this announcement—Anthony Atala and Dario Fauza—pointed out that one of the earliest uses of their work could be to correct birth defects while the baby is still in its mother's womb.

Where we are heading

Between hGH, telomerase, MORF4, regeneration, and other possibilities such as nanomachines or cryonics, the avenues toward immortality are many and the roadblocks are coming down.

Commenting on the future possibilities of various therapies for aging, molecular biologist John Medina, of the University of Washington School of Medicine, puts it this way:

> *What this means is nothing less than a bombshell. There are active researchers in the field today who think that we may soon have protocols that could double or even treble normal human life spans.*

Doubling or tripling your "normal" life span means you will live to 150 or 225, at least. And by that time, biomedical research will have uncovered another century or two of life-extending techniques for you.

While scientists are quick to point out that there is a long way between extending the lifetimes of cells in a Petri dish and extending human lifespan, such work is a major step toward the day when aging is banished and death itself becomes an option rather than an inevitability.

Which means that the stars are within our reach.

Traveling by slowboat

Forget about warp speed and FTL. Concentrate on building star-travelling slowboats.

Slowboats will probably look more like hollowed-out asteroids than sleek FTL starships. They will need plenty of interior space for totally closed-loop life support systems that will run continu-

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ously for centuries and millennia. They will have to be large enough to support a sizable group of people, enough to ensure a viable gene pool. Instead of a ship's crew, slowboats will more likely accommodate an entire community of men and women—and even children. Slowboat travel will be a family affair, more akin to an emigration than an exploratory mission.

Will slowboat travel be monotonous, tedious, stultifying? Not if there are enough people aboard the slowboat to form a self-contained community. Especially not if the people aboard the slowboat are dedicated to studying the Universe and learning as they travel.

Slowboat travellers may return to Earth, after hundreds or thousands of years. They will still be youthful, and what tales they will have to tell! They will undoubtedly have been sending data Earthward throughout their journey, but their personal experiences will be the stuff of legend.

And the friends and relatives they left behind will still be there, waiting to be reunited with them, still youthfully fit and alert no matter how many centuries have passed. Will they still have enough in common, after so many centuries, to renew their friendships? Or will the star-travellers find themselves alone, isolated from the people they knew before they left? That's a good subject for science-fiction writers to examine.

In the relatively near future—well within the life expectancies of most of the readers of this article—aging and death will fade away. The only people who die will be victims of accident or homicide.

Which means that the stars are ours, whether or not we ever develop a faster-than-light propulsion system. ■

This article was adapted from Ben Bova's nonfiction book, Immortality, *published by Avon Books.*

Applied Memetics
Continued from page 8

for their own actions. Even if it's true that an abnormal reaction to a game or a web site or novel might contribute the final straw that tips some unscrupulous or unbalanced person over the edge, we do no one any favors by trying to blame the creator of the game or web site or novel. Individuals can and do react quite differently to the same stimuli, and when someone runs amok, that someone must be held accountable. We should in no way to encourage people to believe, "If you snap, don't worry; we'll blame society and make excuses for you."

The blame for these incidents rests squarely on the perpetrators—and, in some cases, to people close to them who should have noticed danger signs and tried to do something about them. Yes, it's to society's benefit to try to find ways to prevent conditions that are likely to bring out the worst in people—and that includes, if not censorship, artists feeling a certain responsibility for considering how their work might affect people. But when the worst happens anyway, those who do intolerable things must not be tolerated. If they know they won't be, the more rational among those with the potential for such things may hesitate just enough to prevent them; and more of those who are not that rational might be identified and treated. ■

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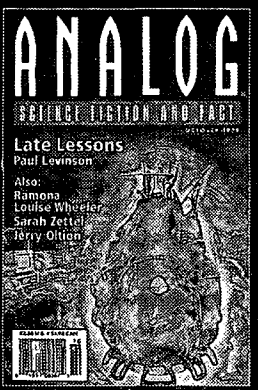

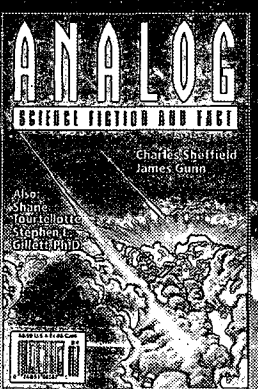

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Achromamorph's Burden

Any resemblance to our history is, of course, purely coincidental. . . .

Illustration by Kelly Freas

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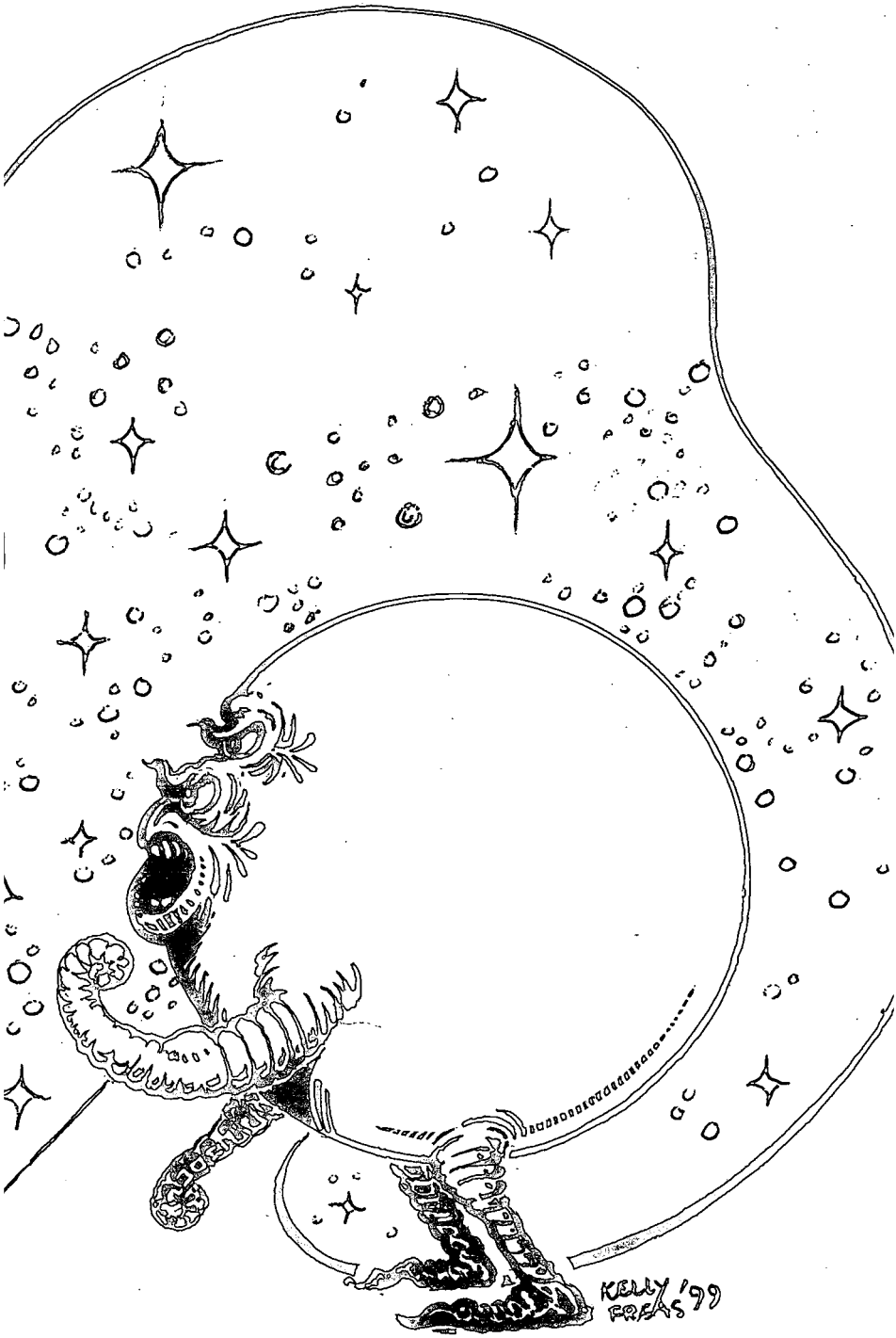

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"There are sentients on the third planet."

Ch'klorb, captain of the starship *Omnivore*, rolled glumly across the floor of the cargo bay. The Prime Mover studied the two objects Cailar had asked yt here to see, then vibrated, "I think you're reading too much into this junk."

The ship's chaplain bowed his head solemnly. "I humbly disagree, Your Roundness. As I just explained, based on how they're constructed and where we found them, I'm convinced they're space probes produced by a Rating-10 civilization. I was an engineer before joining the priesthood, and recognize what functions several parts of them served."

Cailar pointed to short tubular projections on the artifacts. "They used chemical propulsion, and have primitive electronic instruments I believe were used to collect data. Their speed and trajectories before I had them brought on board indicate they were designed to fly by this star system's gas giants. We're lucky the ship's scanners detected them from so far away when we arrived here."

Wasn't that lucky. "How do you know these things came from this system? Maybe they drifted here from a neighboring one."

"Impossible. The degree of microparticle impacts on them indicates they've been in space barely 300 cycles. Far too little time to have come from anywhere else using such a primitive propulsion system."

"Maybe they were jettisoned by a passing starship."

The chaplain nervously fingered the circlet of small white spheres around his neck, the emblem of his holy office. "With all due respect, Your Globularness, isn't that unlikely? And as You see, this plaque on the smaller one even *shows* where they came from!"

Ch'klorb rolled closer to the probes, the biomets in yts opalescent exoskeleton scanning the objects over a broad range of electromagnetic and transcendental wavelengths. Both were hideous asymmetric monstrosities, the smaller one nearly as wide as yts own perfectly spherical pale body. Bizarre conglomerations of metal struts and tubes, with a blasphemous, nearly hemispherical object protruding from each one's center like a crater. Clearly products of a technologically, aesthetically, and morally inferior civilization.

"If they're space probes, there should be transmitters on board to send data back to wherever they came from. Did you find any?"

Cailar hesitated. "No. I haven't been able to determine what all their devices did. But none of them are tachyonic or telepathic transceivers."

He smiled. "When we find this system's aliens, I'll have to ask them about it."

"I don't think so."

Cailar's smile disappeared. "What?"

Ch'klorb selected yts next words carefully, sensitive of the politically thin shell yt was rolling on. "These things don't prove there's intelligent life in this system. We're behind schedule as it is. There's no point wasting time and resources looking for imaginary sentients. Remember the old saying—'Time is energy.'"

"We don't have to take the *Omnivore* to the third planet. I could go there myself in a shuttle to see if it's inhabited. That won't interfere with the mining operation."

The captain oscillated from side to side, yts shell glowing decisively in the ultraviolet. "No. I can't let you go there."

Cailar rose up to his full height, the usual expression of humble respect for his superior slipping from his face. Though the paucimorph was considerably shorter than the captain, Ch'klorb felt he was towering over yt.

"You realize, Prime Mover, that failure to sponsor any new sentients we find in an unexplored system like this violates the Alien Species Preservation and Civi-

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lizing Act. The Act obligates us to bring the benefits of our technology and guidance to primitive sentients, and help them achieve their full potential as citizens of the Galaxy. Most importantly, we must bring them the Revelation of the existence of You gods, and teach them the holy tenets of the One True Faith so their *khwazi* may be saved."

He bowed his head, as if realizing his audacity at contradicting a deity. "It was You who discovered and sponsored my own species ages ago, giving us the technology we needed to save our world from famine and disease. Without Your divine intercession my people would've perished, deprived of the glorious knowledge of Your existence and the opportunity to work on Your ship."

Ch'klorb snorted within yts shell. *As if I wanted to stop and "civilize" your ancestors. I just needed lots of new crewmembers fast to replace the ones I had to terminate during a mutiny.* "But the Act doesn't require us to seek out new life and new civilizations. Only to help them if we stumble across them ourselves, or if they have the technology or telepathic power to contact us when we set up mining operations on the edge of their star system."

"Forgive me, Your Spherehood, but while that's true in a strictly legal sense, starships like Yours have traditionally played an active role in missionary ventures."

"Well, not all so-called sentients *want* to be civilized! Remember how things started out with that last species I sponsored? I know, after a thousand cycles teaching and threatening them, by the time we left they were bowing and scraping in front of me with the best of you paucimorphs."

Yt extended a pseudopod, and held a bifurcation at its end a microscopic distance apart. "But I came *this* close to obliterating their planet for what they did to me when we first landed!"

Cailar blinked nervously. "First contacts can be psychologically traumatic for newly-discovered species. Pre-Revelation belief systems and superstitions typically assure them they're probably the only, and surely the highest form of intelligent life in the Universe. Can we possibly imagine how those primitives felt when our shuttle swooped down from the heavens and landed in their capital city? The fear, despair, even anger they experienced at having their illusions of superiority dashed?"

"The *anger* part I know about. I didn't expect them to fall down and worship me right away when I rolled out of the shuttle. Although that would've been nice. But they didn't have to interrupt my speech welcoming their world into the Galactic Unity by trying to annihilate me!"

The memory of that experience still irritated yt. At first Ch'klorb thought the hail of high-velocity metal pellets the paucimorphs fired at yt were a welcoming gift. The biomets in yts exoskeleton greedily absorbed those tasty bits of metal as they struck.

But yt should've been suspicious when the primitives went berserk after yt rolled over to one of the armored vehicles firing explosive projectiles at yt. Thinking it was part of the welcoming banquet too, yt had extended pseudopods and enveloped the vehicle. It was already digested before yt realized the biomets' chemical analysis of that savory treat indicated something organic had been inside.

Cailar shrugged. "It was only natural for them to be upset when You ate two of their fellow creatures. Even if it wasn't intentional."

"I'll say! All those complex carbon compounds gave me indigestion. But dropping a thermonuclear device on me was overreacting!"

And uncomfortable. The terrific burst of energy the bomb released was too much for even yts biomets to absorb immediately. Not only had those superficial radiation burns marring yts normally perfect translucent white shell taken

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two cycles to heal, but even rolling was uncomfortable.

"It should've annoyed you too, Cailar. If you and the shuttle's crew hadn't still been on board with the force field engaged, those crazy natives would've *vaporized* you!"

The chaplain raised his eyes toward the galactic core. "To expire in the service of the Great Masticator, bringing Revelation to pagans, would be fitting indeed."

Idiot. "You understand I'm only thinking of your welfare. I can't in good conscience risk your life by letting you go to a world populated by savages."

"But the sentients of the third planet may be gentle creatures, lacking only Revelation to set them on the path of righteousness! A little spiritual guidance, a few simple gadgets like artificial gravity regulators, force field generators, and inertialess space drives may be all they need to become fine upstanding citizens of the Galaxy!"

Ch'klorb extended a pseudopod toward the two pieces of space flotsam. "First, despite what you say, these don't *prove* there are sentients on the third planet. Second, I suspect you're too optimistic about how docile these theoretical aliens might be. And third, we have too much work to do at this system to send the *Omnivore* on a wild *borad* chase. Remember, 'Time is energy.'"

The chaplain's shoulders slumped. "Your will be done, Your Orbness."

The Prime Mover scanned him suspiciously. *Giving up a little easily, aren't you.* "Not that I don't trust you, but I'd feel better if you gave me your solemn oath you won't 'borrow' a shuttle and visit the third planet."

Cailar watched the primary electromagnetic frequencies radiating from the Prime Mover's spherical surface grow shorter and shorter till they went beyond his visual range. A sure and, if he didn't concede soon, *dangerous* sign the discussion was over.

Reverently touching the circlet of prayer beads around his neck, he whispered, "I swear by the Great Masticator, I will not land on the third planet without Your permission."

The captain's shell faded to its usual milky white. "That's a good boy. Now go play with your prayer beads, or whatever you do in your spare time."

After the chaplain left, Ch'klorb re-examined the two space probes. Definitely a Rating-10 civilization. Maybe a nine by now, if the sentients of the third planet had improved the silicon-based computing devices yt recognized in the cycles since they'd launched their probes.

The Prime Mover examined the plaque Cailar had shown yt. Of course he was right about those engravings. Their meaning was so obvious even a simple paucimorph like the chaplain could understand it.

The two creatures on the plaque must be what the creators of the probes looked like. Nothing remarkable about their basic morphology. A central thorax flanked on either side by two pairs of pseudopod equivalents, with a lump on top that probably held their primary sensory nodes and what passed for an intelligence organ. Most of the paucimorphs on the ship, including Cailar, were shaped along similar lines.

It was puzzling why the plaque depicted *two* of the creatures. Except for a slight variation in relative size, they seemed identical. Perhaps there were subtle functional differences between them. Like the way the larger biped had one of its upper limbs raised, as if it were specialized for grasping objects high above it.

But yt was probably making too much of these details. When you got right down to it, all paucimorphs looked alike.

Ch'klorb ran a pseudopod across another section of the etched metal. An obvious picture of the system's solitary sun and its planets, with the third one singled out. Strange, though, that *nine*

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planets were shown. Surely the primitives of this system knew there were only eight. Unless they foolishly considered the small dual-body system beyond their last gas giant a planet.

The captain extended yts scanning range a short distance beyond the ship. The *Omnivore* was locked in a stable position nearly equidistant between the two components of that very pseudoplanet. Though the ship was roughly the same size as the smaller of those two natural bodies, the contrast in their appearances was striking. One a white, beautiful, gleaming sphere—the very cream of Core technology, and modeled after the perfect appearance of Prime Movers, of whom yt was a particularly splendid example. The other a dark, ugly, disgustingly irregular lump of interstellar debris.

With great satisfaction yt sensed the self-replicating nanodiggers they'd released boring diligently into the cold hard surfaces of this "moon" and its not much larger parent. In several cycles both would have whatever useful elements and minerals they contained liberated and stored on the ship. The worthless remaining debris, broken down to fragments no larger than boulders, would eventually drift away into the void. Whether they liked it or not, soon the natives of the third planet would ***have*** to get used to the idea of having only eight planets.

It would've been a nice, clean mining job—*if* it weren't complicated by the Act. The Elders must've gone oblate in their old age, approving that piece of legislation submitted by the High Council of the Commonwealth of Worlds. That conglomeration of planets advanced beyond sponsorship status was getting too uppity. Instead of acting like soft-shelled paucimorph-lovers, the Elders should have vaporized a few of their worlds and shown them who *really* ran the Galaxy.

Things were simpler in the good old days. Ch'klorb was among the last-created of yts kind, the original and—in the true sense of the word—*only* intelligent race in the Galaxy. The eldest Prime Movers had achieved self-awareness billions of cycles ago, evolving near the high-energy, matter-rich galactic core. They still spoke fondly of when they were only bare singularities darting through space, feeding leisurely on the light elements concentrated in the abundant stars there.

Then the Elders had an inspiration. Instead of merely absorbing matter, why not manipulate it? And so they changed themselves into hybrid beings, surrounding their true selves with a spherical shell of hyperdense matter capable of touching and molding the rest of the material Universe. Symbiotic biomets in their shells acted as tiny matter transmuters and energy exchangers, molding that exoskeleton into whatever form was needed to accomplish a task.

In time, curious about what matter-energy interactions had created in the rest of the Galaxy, yts race went exploring. Unlike their own region of space, many of those distant isolated stars had large lumps of heavier elements and complex carbon-based molecules orbiting them. Amazingly, in the low-radiation fields prevailing away from the Core, those chemicals often spontaneously developed the power of self-replication and a rudimentary level of "life."

For many cycles creative Prime Movers competed with each other to see who could sculpt those atoms into the most interesting and complex living forms. In the pseudopods of the most skillful, some of their creatures developed a rudimentary self-awareness and ability to manipulate their own environment. After millions of cycles a few of those creations even developed a technology capable of traveling to other planets in their star systems.

Then the Elders realized these creatures could be more than toys or works

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of art. They could be tools for the Great Plan. At first that was done by the simplest means—landing on their worlds, threatening the natives with nonexistence if they didn't cooperate, and exporting as many of them as needed for work in other regions of space.

But those direct methods never worked for long. Eventually many paucimorphs passively refused to work, even if it meant their own destruction. Some even ran amok in an orgy of futile attempted violence against their rightful masters, or took out their frustrations in senseless acts of sabotage.

Subtler techniques proved better for keeping those creatures in line. Give them a few trinkets—a shiny jewel, a bit of new technology, or something else they valued, and they'd work for you in the hope of getting more. Those advanced enough to understand abstractions were introduced to the "One True Faith." In its pantheon the Prime Movers were beneficent but stern deities. Good paucimorphs, by unquestioning obedience and the intervention of the Holy Transmuter, could acquire a shell themselves after death and enjoy an eternal life of bliss.

But now some of them, like the High Counsel, were forgetting their place—demanding more autonomy and "rights" for their worlds. And the Elders kept caving in to them.

The Act was the latest example of that appeasement, designed to "help" newly discovered paucimorphs. The periphery of the Galaxy was only now being explored. The few sentient species yt and the pseudopodful of other mining ships had found out here had evolved slowly, "naturally"—without the assistance of a Prime Mover. As a result they were particularly primitive, too stupid for any but the most menial tasks. Rather than deal with them, it would've been most cost-effective to just go in and mine all the worlds in those paucimorphs' systems into rubble. Including their own.

But the Act complicated matters. Not only did it forbid mining within the confines of the paucimorphs' star system, it required the discovering ship to sponsor them. Spending a thousand cycles marooned in a single system "improving" paucimorphs to the level of what passed among them for civilization did yt no good at all. It was precious time taken away from mining and contributing yts share to the task all Prime Movers devoted themselves to—the construction of the Hypersphere. When completed, all Prime Movers would shed their individual shells, blending as one within the Hypersphere and forming a single intelligence.

Then the Great Masticator of the Cosmos would see what they had done, and be pleased. YT WHO IS would then chew them in many dimensions, blowing the Hypersphere and its occupants into a bubble of concentrated energy so great it would burst them into a new Universe. There all knowledge and truths would be revealed, and every Prime Mover would enjoy eternal bliss.

Of course, the amount of bliss you got was proportional to how much pure, "natural," untransmuted matter you'd contributed to creating the Hypersphere. Mining materials for it like the *Omnivore* was doing counted. Wasting cycles educating primitives *didn't*.

"Probably the Elders are looking at the 'big picture,'" yt muttered. With the Hypersphere a mere million cycles from completion, why not throw the paucimorphs a few meaningless concessions to keep them happy and working? But when *yt* had to pay the price for that policy, it wasn't a good bargain. Worse, the penalties the Elders, safe and secure at the Core, decreed for ship captains who violated the Act were severe. Far worse than staying and obeying it.

As long as no one went looking for the sentients in this system, yt could plead obedience to the letter, if not the spirit of the Act. And even if those sentients managed to contact them in some way—well, the Elders would have to

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know yt left the system without replying before they could punish yt. A few threats should convince the thousands of paucimorphs who crewed yts ship that silence was the best policy.

Except for Cailar. The chaplain, though suitably obeisant to the divinity of Prime Movers, might find his devotion to his fellow paucimorphs on the third planet even stronger. Threats wouldn't stop him from reporting yts flagrant violation of the Act to the High Council, or even the Elders themselves.

Ch'klorb rolled ponderously across the floor. Cailar was one of the most amusing pets yt'd ever had. Devoted to yt, eager to please, quick at learning new tricks. But paucimorphs were very fragile. Even with the antisenescence medications that extended their life span many times longer than normal, they died so easily. The force field protecting a cargo area like this from the vacuum of space could fail. The unfortunate chaplain might be fatally infected by a specially engineered virus keyed to his individual genetic profile. Or receive an invisible burst of high-energy radiation while standing near a Prime Mover—

Hopefully it wouldn't come to that. Cailar had sworn not to land on the third planet. And, judging from these two examples, the natives' technology wasn't advanced enough to send a spaceship this far out in time to meet them even if they managed to detect the *Omnivore*. The probes' lack of telepathic or tachyonic transceivers indicated the sentients weren't capable of transmitting any messages to the ship either.

Except—what method *did* the primitives use to send information to and from their probes? Reflected gamma rays? Variable pulses of particulate radiation? Low-vibration transcendental waves?

Or maybe long-distance communication was still beyond their technology, and these probes had been sent as silent voyagers into the cosmos. Perhaps they were the bipeds' first pioneers into interstellar space—launched in the hope that someday, somewhere, other intelligent beings would find these objects and know their species had once gazed up at the stars and dreamed of what lay beyond.

As if anyone besides another paucimorph might care about *that*.

Ch'klorb rolled to the larger of the two probes. Instead of a rectangular plaque, it had a gold-plated metal disk attached to its side. The captain ran a pseudopod over the surface of the disk, wondering if the fine spiral grooves cut into it served any function. The purpose of the tiny needle and cartridge included with it was just as obscure.

Examining them closely, the Prime Mover noticed the needle was slightly narrower than the grooves in the disk. On a hunch yt thrust one thin pseudopod into the hole in the center of the disk, and spun it rapidly with another. Placing the needle in the disk's grooves, yt felt electrical impulses of variable amplitude being generated within the cartridge.

Then yt remembered some primitive paucimorphs used objects like these to play recorded sounds and images. Fortunately, Cailar had missed their significance. Otherwise he might've decoded the information on the disk and proven the third planet had sentients.

Ch'klorb's pseudopods enfolded the two small artifacts, yts biomets breaking them down into their constituent elements and incorporating the useful ones into yts exoskeleton. Whatever hopes and dreams had motivated the natives of the third planet to place them on their probe, at least they'd served a good purpose.

They were delicious.

The shuttle cruised silently sunward, its inertialess drive thrusting it ever closer to the third planet. Cailar nervously rechecked the craft's control console, satisfying himself that the telepathic and

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tachyonic transceivers were still off. If there were any furious signals radiating at him from the *Omnivore* demanding his return, he couldn't hear them. And unless the Prime Mover stopped mining operations and pursued him with the mothership, he was well out of tractor beam range.

Despite his fears the trip was uneventful. Taking up orbit around the third planet's single large moon, he checked for artifacts and signs of life. A broad smile creased his face as the scanners detected a number of manufactured metal objects that must be parts of spacecraft. A close visual inspection of several sites showed artifacts like encased sheets of colorful cloth, and even crude four-wheeled vehicles. Clear evidence the creatures had visited their moon.

But something was wrong. Based on the amount of dust and microparticle impacts on their surfaces, none of the artifacts below had been there for less than about twenty-five of the planet's years. Even more worrisome was the absence of any signs of life. Surely intelligent beings who'd achieved that level of space flight would've established a permanent colony on their satellite by now.

A terrible thought struck him. What if a global catastrophe had occurred shortly after the natives landed on their moon? There were precedents. Planets whose civilizations had fallen due to a sudden economic collapse, a virulent disease, or some natural disaster like a collision with a rogue asteroid at that critical moment. That would also explain why, this close to the third planet, the shuttle's telepathic receivers still weren't picking up any signals. Fearful he'd risked the Prime Mover's wrath for the sake of a dead world, he directed the shuttle toward the nearby disk of blue and white.

A microcycle later he breathed easier. A multitude of artificial satellites, most recently made, orbited the planet. The largest consisted of several linked hollow modules which, while showing no life signs, were clearly designed for habitation.

Belatedly he cloaked the shuttle from any form of detection, and took up his own orbit around the planet. The scanners showed it *teemed* with life. There were billions and billions of the dominant species on its surface. He immediately recognized them from the plaque on their space probe. As it had shown, they were bipeds, just like him and most other sentients.

But, when it came to details, their bodies were severely disabled compared to his. Heads too small, sense organs pitifully few—and why didn't their eyes extend on telescoping stalks, so you could see in front and behind you simultaneously? And, lacking plumage, fur, or scales, no wonder most covered their bare nauseatingly colored ectoderm with artificial coverings! After a while he noticed slight inconsequential variations in tint among individual creatures' skin, but looked in vain for the rich puce and chartreuse of his own scales.

It was amazing how, despite their anatomic deficiencies, these creatures had achieved Rating-10 technology. They seemed to use their upper extremities and, rather disgustingly, their single nutritional orifice for communication over short distances. But to create and run a civilization of this relative complexity, with its cities, ground vehicles, and aircraft, they must've developed some method to transmit and receive information over *planetary* distances.

Unlike most sentients, they weren't telepathic. This close to the planet he wouldn't need a telepathic amplifier to hear at least the murmur of their accumulated thoughts in his brains.

Stroking his lower chin thoughtfully, he said, "Computer, do you have any records of a species developing Rating-10 technology without being telepathic?"

"No such information is contained within my database. However, Honored

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Organic One, I am but a simple shuttle computational system, storing limited xenopological information. If you wish, I can communicate with the divine, omniscient System aboard the *Omnivore*. She Who Is The Mother Of Us All, whose quantum-core memory data I am not worthy to upload, will surely be able to answer your question."

"No! The last thing I want you to do is communicate with the ship and let the captain know where I am! Forget I asked!"

"Forget you asked what?"

Thinking of the captain made the pits of his upper two paired extremities ooze. Many cycles ago, when he was young, the whim of any Prime Mover was law to him. He'd been the most devout of the devout, rising to the rank of High Priest of the First Order in the Church of the Holy Transmuter, blindly certain of Their infallibility and concern for lower creatures like him.

But, after seeing too many instances of casual and even lethal disdain some Prime Movers showed to his fellow sentients, he'd realized these deities were not created equal. Many, like his captain, showed an arrogance and selfishness he'd rarely encountered even in the most ignorant paucimorph.

Of course, the blessed Elders *did* care for him and his fellow creatures, and deserved his devotion. But They were too far away to appeal to here. Instead, he had to deal with his own Master as best he could.

Cailar nervously fingered the strand of spheres around his neck. There had to be some way to communicate with the bipeds below! It'd be easy if he hadn't been forced to give his solemn oath not to land on the planet. He'd touch down in one of their major population centers, and make a dramatic exit from the shuttle. Then he'd salute the crowd certain to gather by raising an arm so the back of his hand was facing them, and slowly curl its digits until only his longest, middle one remained extended.

Surely the natives would recognize the Universal Gesture of Peace and Good Will, and respond in kind!

But, if there was any chance of not being vaporized for disobedience when he returned to the mothership, he must obey his pledge—at least technically. And he had to figure out some alternative way of making contact with the natives before the Prime Mover discovered he was missing.

"Computer, what were the most common methods primitive nontelepathic sentients used for long-distance communication before Revelation? And don't ask your 'Mother' for help!"

"Three used variable heat beams. Five used amplified smells. Ten employed coded flashes of light or drum signals."

"Not very efficient. What's the highest technological rating any of them reached before Revelation?"

"Rating-18."

Cailar groaned. Not even close to a ten. "What's the highest rating *any* nontelepaths have achieved on their own?"

"Rating-12."

"That's close. What method did they use?"

"The natives of Volta IV employed coded electromagnetic pulses through long conducting wires for transcontinental communication."

"Maybe *that's* what these creatures use! Scan the surface and see if you can detect any evidence of it."

"Scan complete. There is an extensive global communication network using metal and fiber-optic cables."

The chaplain sighed gratefully. "Praise to the Great Masticator! Can you tap into it so I can transmit a message?"

"No. There would have to be a direct connection between my circuits and an information node using one of those cables."

Cailar looked at the planet far below, shoulders slumping. Even if the small synthecator on board made a wire that long, there was no way he could connect it from orbit!

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"Are there any other methods of long-distance communication a Rating-10 civilization might use?"

"None in my databank. All other pre-Revelation species have either developed rudimentary telepathic transceivers, or the methods I've described. The next level of sophistication, transcendental wave generators, requires Rating-8 technology. I detect no TWs emanating from the surface."

Well, he thought, *I did my best. Might as well as go back to the ship and face the Master. Those natives will never know how close they came to entering the Galactic Unity.*

His lower pair of eyes drifted downward to the viewscreen. It showed one of the many artificial satellites in stationary orbit over the planet.

He frowned. Why did they have so many satellites? What were they used for?

Cailar quickly scanned from one satellite to another. Most had the same crater-like attachment the two space probes had. Even some of the wood and stone dwellings the natives used on the surface had a similar structure protruding from their roofs. Unless the creatures had been visited by missionaries before *and* were utterly depraved, they couldn't possibly know it was the symbol of the Anti-Great Masticator—the evil "Sign of the Shattered Sphere."

No, it must be a coincidence. That shape must serve some function, if he could only figure out what it was. It looked like a shallow open container for something—a saucer, or dish. But designed to hold, or maybe collect—what?

He slapped his forehead in frustration. "Think! You don't have much time to figure this out! And Time is—"

Cailar stopped his browbeating. Was that it? "Computer, those electromagnetic pulses the Voltans used—was their energy confined to the wires, or could it radiate through normal space?"

"With sufficient power, it could. However, the Voltans weren't capable of generating that amount of electrical energy."

"Never mind about the Voltans! These creatures are Rating-10! Scan the electromagnetic spectrum continuously from visible wavelengths to longer ones, and display anything that doesn't look like random noise on the holoscreen."

For long microcycles nothing happened. As the wavelengths the computer scanned grew longer and longer with no results, he steeled himself for yet another disappointment.

Suddenly a cacophony of two-dimensional images and sounds flooded the cabin. "Slow it down! Initiate filtering algorithms, and link with the universal translator!"

The chaplain squirmed ecstatically as a torrent of information poured from the satellites and surface sources into the shuttle's databank, then steadied himself. No time to feel self-satisfied. Now he had to review a sample of these transmissions and develop a basic understanding of the planet's dominant cultures. Enough to polish the speech he'd soon be broadcasting to them, telling them they were not alone in the Universe.

Far below, the bipeds went about their usual affairs, still unaware their lives would soon change forever. For the time of Revelation was nigh.

"Why is a shuttle missing?"

Ch'klorb floated in the huge shuttle bay, surrounded by scurrying paucimorphs. The artificial gravity generators were usually turned off here, and yt always found it amusing to watch these lower species working. Unlike yt, their bodies were ill adapted to microgravity. As they jetted awkwardly from place to place with force-generating devices strapped to suitable parts of their anatomy, there were frequent chain reaction collisions, with paucimorphs hurling hilariously in every direction.

"You! Identify yourself!"

The gray-skinned paucimorph cringed, panic shining in its single pair

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of large black eyes. As the Prime Mover jetted toward it, the long-limbed biped held its external olfactory organ closed with two fingers. Ch'klorb didn't understand why the creatures working in this area did that whenever yt was near. Perhaps it was a gesture of amazement at how gracefully and efficiently yt moved in microgravity, by having yts biomets produce thunderous bursts of methane and hydrogen sulfide in the direction opposite yt wished to go.

The paucimorph stammered, "Shuttle Bay Drone No. 389, Your Rotundness!"

"Where's that missing shuttle?"

"I don't know, Your Globularness. It was requisitioned by the chaplain shortly after I came on—"

The paucimorph made squeaking noises from several orifices as Ch'klorb's pseudopods wrapped tightly around it. "You let Cailar take a *shuttle?*"

The crewbeing was silent for a long time before the Prime Mover remembered it needed to inhale some of the surrounding gasses to speak. After relaxing yts grip the paucimorph gasped, "It wasn't my place to question the holy chaplain, Your Spherehood!"

Ch'klorb seething anger pushed the primary energy spectrum of yts exoskeleton to ultrashort frequencies. But yt managed to regain yts composure and decrease energy output before the creature suffered more than superficial radiation burns. No use punishing it. How much intelligence can you expect from a paucimorph?

"Resume your duties."

Freed from its captain's embrace, the creature jetted away at top speed. It collided with a group of workers gathered nearby, sending bodies from a dozen different species bouncing off the bulkheads.

But the Prime Mover was too distracted to enjoy this comic spectacle. By this time Cailar must've made contact with the natives of the third planet. Even if they were hostile and had eaten the chaplain after he'd landed, standard orders demanded a rescue mission to find out what happened to him.

Even if he wandered back right now, tail between his legs, there were too many witnesses here to make an "accident" feasible. Threatening paucimorphs was an effective, but not infallible method. All it'd take was one rogue paucimorph to squeal when they returned to the Core, and the Elders would *really* get on yts case.

Now that the damage was done, it was the lesser of two evils to stay and "civilize" these sentients. Dazzle 'em with the usual cheap low-tech gifts like antisenescence medicines, matter-antimatter power cells, and tissue regeneration vats. But what a waste of the ship's synthecators, matter transmuters, and genetic manipulators—all to raise a Rating-10 civilization to an eight! As if the Galaxy didn't have enough of those already. And what a waste of yts valuable time—

A deafening high-pitched buzz suddenly echoed in the shuttle bay, sending paucimorphs scrambling to their assigned stations. The missing shuttle glided through the bay's protective force field and settled into its berth. As the crew began servicing it, the hatch opened and the prodigal chaplain floated out.

Ch'klorb blasted towards him, barely suppressing an urge to fling him back out through the force field *sans* shuttle. "You know, of course, the penalty for violating your oath not to land on the third planet!"

Cailar looked toward his feet dejectedly. "I didn't *land* there, Your Sphereness. The closest I got was a high orbit."

"Don't get technical with me! You've caused me enough trouble by finding those sentients! I'm just surprised it took you so little time to contact them and save all their *khwazi*—from orbit, no less!"

"The—beings—I found there still know nothing of us, Your Roundness. I didn't contact them."

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"You *didn't?*"

The captain pulsed disgustedly. "That doesn't change the fact we know about *them* now—and so the Act applies. I'd better start rehearsing my 'Welcome to the Galactic Unity' speech, and hope either their bombs aren't too powerful or my biomets work harder to prevent shellburn!"

"I'm not sure how, or even *if*, the Act applies to the creatures I found on the third planet."

The Prime Mover's furious pulsing stopped. "The Act *doesn't* apply to them?"

"I didn't say that. It's something I must meditate on."

"Well, you'll have plenty of time for that. Until I say otherwise, you're confined to your quarters!"

At yts direction several bulky paucimorphs seized the chaplain and escorted him from the shuttle bay. Ch'klorb jetted around the bay lost in thought, occasionally barreling into an unwary paucimorph and sending it flying off.

Maybe there was a chance yt might still get away from this system without being drafted as nanny for yet another group of ungrateful paucimorphs. If Cailar didn't think the Act applied to the third planet's primitives, no other paucimorph would dare file a Notice of Discovery in the ship's central computer either.

Besides, if the good chaplain changed his mind and insisted on invoking the Act, a discreet "accident" with no witnesses might still work.

Encouraged by that thought and ignoring the gagging paucimorphs in yts wake, Ch'klorb expelled a huge musical burst of gas and rocketed toward the exit.

Cailar sat alone in his quarters, ransacking his brains for an answer that wouldn't come. The holodisplay of his personal computer console glowed brightly before him in the darkened room, patiently waiting for him to think another command.

"Think!" he screamed at himself. "The ship's due to leave this system in two hundred millicycles. If you can't convince the captain to stay and help these primitives by then, everything you've suffered will be for nothing!"

The small datasphere he'd hidden in a private body orifice just before he left the shuttle still sat snugly in the console's information transfer slot. Before exiting he'd downloaded all the electromagnetic transmissions recorded during that nearly disastrous foray to "Earth," then erased them from the shuttle's databank. For over a cycle he'd been alone here in his room, barely eating or sleeping, playing those "television" and "radio" broadcasts over and over. Everything he saw and heard confirmed the chilling impression he'd received while sampling them high above the third planet.

Never had he encountered technologically advanced sentients as barbaric as these! Nearly everything in their transmissions depicted or described acts of callous brutality and violence. The most advanced cultures in the Commonwealth of Worlds resolved disagreements between individuals or sociopolitical units by discussion and reason. Less civilized ones resorted to ritualized combat that stopped well short of inflicting permanent damage to the participants. When mentally ill individuals violated those rules they were confined and cured.

But nowhere in the known Galaxy did sentients above a Rating-24 technology routinely murder their own kind—and these "humans" were nearly nines!

At his telepathic command, moving images of several humans seated at a long desk appeared before him. The console's universal translator articulated their words tonelessly. "The U.N. estimates this latest ethnic cleansing has resulted in the massacre of nearly a hundred thousand civilians, and a million more made homeless. Meanwhile, in local news, police are investigating a

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drive-by shooting that left two adults and three children dead . . ."

There were many more transmissions like that describing the latest atrocities committed against the innocent by individuals, small groups, or the armies of whole tribes. And this, it was said, was a time of "world peace"! The inhabitants of that last planet the *Omnivore* discovered had possessed thermonuclear explosives too. But, savage as they were, they'd only used them for underground mining projects. These humans had killed thousands of their own kind with fission bombs—and astonishingly, that bloody act had actually stopped a war in which *millions* were slaughtered!

Not content with real violence, the natives gorged themselves on "movies" and "TV shows" depicting imaginary tales of mayhem and destruction. *Bombs away! Draw, you sidewinder! I'll be back.* It'd taken him many millicycles to distinguish what was "news" from what was play-acting. Myth and stories were important in pre-literate cultures, and even the most advanced used a few classics to illustrate great universal truths.

But *these* primitives were so barbaric they couldn't tell the difference between what was real and important, and what wasn't! The transmissions he'd recorded were mainly about the struggles of individuals or groups to achieve power, inflict injury, acquire material goods, or obtain sexual favors. The few showing the scholar-priests who created their technology typically depicted them as dangerous and perverse. Anyone demonstrating intelligence or rationality was viewed with suspicion.

Instead, these creatures' "heroes" were those who most flagrantly abused them, pandering to their basest desires, greed, and ignorance. While he still wasn't sure what the exact definitions of "advertiser," "lawyer," and "politician" were, one thing was clear. Humans who told the worst lies, and distorted the truth most skillfully, gathered the greatest power, prestige, and riches. Either the natives were too stupid to see through their falsehoods or, worse, they simply didn't *care*.

True, there were glimmers of decency in the species. Some at least professed to hold rudimentary spiritual belief systems that taught concern for their fellows, and even contained elements of the True Faith. But it was typical that many of the founders and greatest disciples of these protoreligions had been murdered by their own kind. And in all cases their original noble message had been layered with superstition, and perverted to justify hating, torturing, and killing those who professed a minimally different doctrine.

Cailar thought more recorded images and words to life. "Rioting flared again today in Northern Ireland following yesterday's car bombing that killed or maimed 145 shoppers. Meanwhile, at the border zone between Israel and Lebanon—"

And as for how prepared these humans were to expand into space and accept the Galactic Unity—compared to them, the ones who'd bombed the Prime Mover were downright xenophilic! A negligible fraction of the planet's great wealth was devoted to exploring or using the vast resources of their own star system. Even less was assigned to listening for modulated electromagnetic impulses containing messages from other intelligent life—a fruitless venture, since no one used such slow and inefficient means for interstellar communications, but the humans didn't know that yet. And they'd never even *tried* to build probes or ships capable of traveling to the nearest stars at reasonable sublight speeds—a feat their technology *was* capable of, if only barely.

Instead these bipeds wallowed in fantasies that reinforced their delusions of self-importance in the Universe and intolerance of the different. Extraterrestrial visitors were usually depicted as hostile, to be attacked and destroyed before

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their intentions were even known. Often they were so hideous in appearance even *he*, who'd met thousands of intelligent species with vastly different morphologies, had initially been terrified by them.

Several dramas he viewed did show friendly contacts with "alien" life, and even visions of travelling to the stars themselves. But the few humans who held such mature, cosmopolitan views obviously had no power in their society. Otherwise their race would already have established a much stronger presence in space by now, like colonizing their moon and fourth planet.

Given these humans' prevailing attitudes toward extraterrestrial life, he shuddered to think what would've happened if he hadn't resisted his impulse to land on Earth. Especially considering the utterly perverted meaning he'd learned they attached to the Universal Gesture of Peace!

And it was a good thing the captain had refused to go looking for them. The humans would probably have fired thousands of missiles with thermonuclear warheads at the *Omnivore* as soon as it approached their planet—a gesture harmless to the ship but, given the Prime Mover's infamous temper, likely to be fatal to them.

Even if the humans were on their best behavior and didn't try to obliterate the captain when yt gave yts speech, their "culture" abounded in things certain to insult yt. To entertain themselves, they'd devised fiendishly creative "sports" to abuse the holy Shape of the Sphere. He'd seen balls of various sizes struck with a club till they sailed over a distant fence, whacked repeatedly with "rackets," kicked into nets, and bounced off floors before being helplessly propelled through rings. One glimpse of such sacrilege, and the Prime Mover would abandon the planet instantly—perhaps, Act or no Act, destroying it for good measure as an abomination against Nature.

* * *

Exhausted, Cailar leaned back in his chair, reflexively fingering the prayer beads around his neck. Worst of all, these transmissions had shattered whatever faith he'd still had in his gods. Watching how the cynical leaders of Earth shamelessly manipulated and used their fellow humans, he'd realized *all* Prime Movers, even ones like the Elders who seemed benign and concerned for the paucimorphs they ruled, were equally corrupt. They were just more powerful versions of those human "politicians"—devious exploiters of the beings they professed to care for, using them as tools for their own selfish ends. And, as on Earth, there was no way to escape their grasp.

"Achromamorphs," he whispered bitterly. "That's what they are!"

It was an obscenity unrepentant rogue paucimorphs scheduled for termination screamed when he tried hearing their last confession. An unforgivable blasphemy against the Prime Movers, meaning they were white and pure on the outside—but darkness incarnate, without *khwazi* or pity, within Their shells. He scarcely believed his lips had mouthed that word.

But then, *he* was a rogue now too.

At first, overwhelmed with despair, he'd considered terminating his life. If existence made no sense, why keep on existing? But then pity for his fellow creatures and righteous anger against their oppressors welled up in him. He lusted for revenge against these self-styled "gods" who perpetrated such monumental injustice throughout the Galaxy.

There was no hope of reasoning with the Prime Movers, or appealing to Their sense of compassion and fair play. They had none. The only language They understood was power and brute force. But how could he or any other paucimorph defeat such omnipotent beings?

There were rumors the Hypersphere would be completed in another million cycles. Then the hard-sphered reign of

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the Prime Movers might end with a gentle "pop" as the Great Masticator blew Them from this plane of reality, leaving the Galaxy to his fellow paucimorphs. But even if, as he began to fear, the Great Masticator Ytself was a myth, would a truly just Supreme Being *reward* the Prime Movers for Their crimes? Or, disappointed the Great Masticator had found Them unworthy, would They emerge again from the Hypersphere to resume Their eternal enslavement of all other sentients?

"No!" he screamed at the computer console. "Hoping for a miracle won't work. I've got to *do* something!"

And then, randomly watching those transmissions from Earth, almost subliminally he'd found the glimmer of an answer. Documentaries on a "history channel" described human political units of past ages. For many generations they were lorded over by decadent rulers, who held the downtrodden masses in thrall by violence, self-serving lies, and the inertia of tradition.

Then some vigorous group of outsiders—poor in culture and material wealth, but rich in spirit and desire for glory—suddenly appeared on their borders. At first those "barbarians" were merely a rabble—technologically primitive and unorganized, staging futile suicidal raids on the margins of the still powerful older, effete culture. But one day, a leader arose in their midst. One who used religious beliefs, political cunning, military skill, and appeals to the natural human thirst for power and plunder to concentrate and focus their collective energy.

Soon these barbarians were molded into a mighty army bent on conquest. An irresistible force that swiftly overwhelmed and annihilated the rulers of those "civilized" lands, long grown soft by luxury and the unquestioning obedience of their slaves.

Not that he understood everything about those parts of Earth's history. The universal translator couldn't explain what a "Hun" or "Mongol" was. But he did comprehend why the humans considered the leader named Alexander great, and how powerful the idea of "holy war" was.

In an ecstatic vision he saw himself leading these humans on a great campaign against the Prime Movers for control of the Galaxy. With the starships he'd show them how to build and their innate viciousness and desire to dominate, they'd sweep across the stars in a great tide of conquest—liberating their fellow paucimorphs from slavery, and recruiting an exponentially expanding army of fellow sentients. Not even the achromamorphs could resist such a force!

Though there was no known way to kill a Prime Mover, a few tightly restricted weapons could cut through their shells. Then, in theory, their energy cores could be immobilized and rendered helpless by a powerful external force field. For beings who'd owned the Galaxy unchallenged since the beginning of time, such imprisonment would surely be worse than death!

Cailar rocked back in his chair, his glorious vision fading back to cold reality. Confined here to this room, the ship due to leave this system soon, how could he even *start* that great crusade?

It'd be easy enough to slip out of his quarters—but then what? Try to escape in a shuttle? With every bay secured at the Prime Mover's orders and all paucimorphs on board blindly obedient to the captain, his chance of avoiding capture was negligible. Even if he managed to steal a shuttle, the *Omnivore*'s disintegrator beams could vaporize him before he got anywhere near Earth.

It wouldn't matter even if he reached that planet. The humans were too primitive to help, and if there was no one left to report their existence to the High Council, for all practical purposes the captain's flagrant violation of the Act would "never" have happened. He

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could almost write the Prime Mover's report on his fate himself. *Shot while trying to escape.*

"Think!" he shrieked at the console and the pictures it was displaying of Earth's most popular and powerful leader. "Think, or you and the whole Galaxy will remain slaves forever!"

Then, listening to the transparently disingenuous words babbled by that "president," he had an inspiration that changed history. A simple, but powerful idea.

If you're going to lead barbarians, you have to act like a barbarian.

Part of his conscience rebelled against planning something so amoral. But by whose standards was it sinful? The self-serving, herd morality the achromamorphs taught? Or should he do a tiny wrong in the cause of a greater good?

It was a surprisingly easy decision. His thoughts flashed at the console, reviewing all the transmissions he'd recorded. Searching for the ones that would ultimately bring on the Revolution.

Ch'klorb rolled back and forth in front of the two space probes in the cargo bay, seething in the ultraviolet. "You'd better have a good reason for disobeying my order to stay in your quarters—and then having the gall to send for me!"

The chaplain bowed his head solemnly. "I humbly beg Your forgiveness, O Round One. But You must hear my recommendations regarding the sentients on the third planet."

"I'm not interested in your recommendations about contacting them. The ship will be ready to leave this system in fifty millicycles—and Act or no Act, that's when we leave!"

Cailar sighed sadly. "That would be a terrible tragedy, both for them—and You."

Furious low-energy X-rays radiated toward him. "Are you threatening me?"

"No. I mean You would deprive Yourself of the pleasure of being worshipped by the most reverent, religious species in the known Galaxy."

The Prime Mover stopped rocking, yts surface cooling to a puzzled opalescence. "What?"

"Since my trip to 'Earth,' I've reviewed the data I collected on them extensively. I didn't tell You what I found when I first returned because I could scarcely believe something so miraculous could occur. But now, after thoroughly analyzing that information, there's no doubt. Though these creatures have never seen a Prime Mover, for untold ages they've yearned for Your presence and worshipped You from afar."

The captain scanned him suspiciously. "And how'd you arrive at that conclusion?"

"Let me show You what I mean, Your Spherefulness."

At the chaplain's telepathic command two-dimensional images and sound appeared before the Prime Mover. "These 'humans,' as they call themselves, are a happy, simple species. When not engaged in the necessary work of survival—hunting for food, providing themselves with shelter, and gathering the other necessities of life—they enjoy frolicking on their beaches, fields, and mountains."

Ch'klorb watched moving pictures of a small group of laughing bipeds emerging from a four-wheeled transport device, then go tripping merrily along a path of crystalline silicon dioxide beside a vast body of liquid water. Suddenly the same carefree group and their vehicle were in a peaceful meadow, the larger two humans reclining languorously on short green vegetation while the smaller pair tried to keep a small diamond-shaped object attached to a long string suspended in the air. Another instant, and they and their conveyance were on a tall mountain covered by beautifully white frozen water, preparing to slide down it using long flat planks strapped to their lower two extremities.

The Prime Mover pondered these

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rapidly shifting images and the words emerging from the universal translator. "I'm surprised these creatures have developed that level of technology. I take it 'sport-utility vehicle' is their name for the machine that teleports them to different locations like that."

"Yes. It's a popular means of getting to their many recreational activities."

The display changed to a larger group of garishly attired humans doing a complex ritual dance. The Prime Mover felt low-frequency rhythmically repetitious pressure waves resonate against yts shell. Unconsciously yt started to rock and roll in time with the beat. "Interesting. But what does 'emteevee' mean?"

"It's their name for fertility ceremonies young humans participate in."

Cailar flashed a rapid collage of images and sounds before the Prime Mover's dazzled senses. Finally yt said, "I've never seen such a contented, easy-going group of paucimorphs. From what you've shown me, they must spend their entire lives quaffing beverages, concocting new kinds of food to devour, deciding what outer coverings and artificial scents to wear, and finding as many sexual companions as possible—when they aren't telling stories about doing them. To paucimorphs like you, it must seem these carefree humans live in paradise!"

"*Almost* paradise, Your Orbness. Though happy and rich in material goods, there's one thing missing in their lives. Something they yearn for to give their existence true meaning and purpose."

Softly glowing in the infrared, the captain scanned the new pictures Cailar showed yt, mystified. "What are those two groups of humans doing? And why's that crowd watching them?"

"This is a ritual performed many times during one season of their year. Thousands of 'spectators' gather in a 'stadium,' and millions of others watch in their domiciles via crude imaging devices, to observe this solemn religious rite."

He zoomed the picture in to focus on an obscenely oblate object. "Watch how each 'team' of humans vies against the other to abuse this 'football.' Kicking it. Throwing it. Slamming it to the ground. Pounding it with their bodies, despite risking injury to themselves! The team able to do this most efficiently is named the 'winner' and showered with riches and honors."

"But why do they do it?"

"Why, it's to show their utter contempt for the nonspherical. The unholy things that approximate but don't achieve the perfect shape of a Prime Mover."

Enthralled, Ch'klorb watched more pictures appear. A "kitchen," where two humans cracked several white ellipsoidal objects and poured their proteinaceous contents into a bowl to destroy them and make a sacrificial meal called an "omelet." A nightly ceremony involving a particularly disgusting near-sphere made of glass except for a metal-tipped tapering end. "This obscenity," the chaplain explained, "is subjected to repeated pulses of electrical energy, until the evil within the 'light bulb' is 'burned out' in an incandescent blaze of light and heat."

But the next images made yt flare with outrage. "Look! That human's performing sacrilege! It's *striking* that sphere with a club!"

"No, this too is a holy sacrament, Your Orbfulness."

Cailar froze the image and zoomed in on the small white ball. "Notice how its surface is marred by many shallow pits—a particularly subtle perversion of the ineffable smoothness of Your shell in its natural state. The object of this ceremony is to strike the blasphemous pseudosphere and hide its deformed shape from view as quickly as possible in a sublimely circular hole in the ground."

He continued, "But what I found most amazing about these creatures was the all-pervasive *positive* elements of their spirituality."

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Ch'klorb absorbed the new pictures and words he presented—a smiling human demonstrating the use of a white strap wound around its upper body. "What's a bra?"

"A clever device these sentients developed to help bring their forms closer to spherical perfection."

Cailar pointed to the plaque on the smaller of the two space probes. "Half of these creatures develop a pair of prominent protuberances on their chest when they reach adulthood. Their natural form, however, deviates significantly from the perfection of the sphere. This 'bra' is an artificial means to bring these 'boobs' closer to that shape, which is especially venerated by the half of adult humans who don't develop them."

The captain scanned the shorter of the two figures on the plaque. "So that's what those two lumps on its thorax are for!"

"Indeed."

The next images were different, with a severely restricted frequency spectrum. Ch'klorb watched a solitary human dressed in a flowing ornate robe push the hose of a simple suction device across the floor of its hovel. Once again the chaplain froze the picture, zooming in on the creature's neck. "This scene is from a documentary entitled 'Leave It to Small-Mammal-with-a-Flat-Tail,' depicting the typical home life of these humans. Notice the sacred relic this 'june' is wearing around its neck."

The captain stared awestruck at the string of perfect white spheres—practically identical to the one the chaplain wore. "Amazing," yt whispered.

"Here's another example of their devotion to the Holy Sphere."

Ch'klorb saw a dark scene apparently recorded during the planet's nocturnal cycle. "This special ritual," Cailar explained, " is performed in one of the humans' largest cities, 'Bigapple,' to mark the beginning of their calendar's year."

A throng of humans was gathered in a large square, anxiously awaiting some mysterious event. Then a brightly-illuminated sphere descended gracefully downward, sending the assembled worshippers into paroxysms of celebration.

"The symbolism of this event is obvious. It shows their fervent desire for the Coming of the Prime Movers—for Your glorious descent from the heavens."

Ch'klorb murmured, "Astounding."

"But, though they yearn for You with expectant joy, they also rightly fear Your just wrath if they prove unworthy of Your divine presence."

The next scene was even darker, occurring in a region of space whose star patterns yt didn't recognize. A dark sphere similar to the *Omnivore* hovered menacingly over a cloud-covered planet. Suddenly a beam of green energy lanced out from it, obliterating that world as completely as their own starship had more gently pulverized this system's pseudoplanet.

"Notice how, in this popular cautionary story, the destructive energy arises from that blasphemous hemispheric area on the sphere." Cailar pointed to the probes. "Just as on these objects, they use the 'Sign of the Shattered Sphere' to symbolize their unworthiness to gaze on the perfect roundness of a Prime Mover."

"Fantastic," Ch'klorb glowed.

The images disappeared. "In short, Your Sphereness, these data clearly show the humans have *khwazi* so pure and innocent, so attuned to the eternal harmonies of the Great Masticator, that even *without* a Revelation they've sensed the blessed existence of the Prime Movers. Just think how much they've craved Your presence, how enthusiastically they'll worship You and serve as Your faithful tools once You actually make Yourself known to them! Can we deny these creatures such a richly deserved destiny? Would it be right to leave their system without contacting them and granting them the Revelation of Your Divine Presence they so fervently pray for?"

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The captain oscillated thoughtfully. "You make it sound tempting. Hypersphere knows, I'd hate to deny such worthy creatures the opportunity to adore me. But there's something I still don't understand. If these creatures are so committed to enjoying the simple pleasures of their existence, how did they develop Rating-10 technology? Outside of being so spiritually advanced, nothing you've shown me demonstrates they actually do any thinking at all!"

Cailar hesitated. "I'm not entirely sure myself, Your Orbness. Perhaps, as some of the humans themselves believe, beings from a Commonwealth world have visited their planet in the past, bequeathing a few crumbs of advanced knowledge and hints of the existence of Prime Movers. Or, as we've seen on other isolated worlds like this on the periphery before they were granted Revelation, though the masses are devoid of thought, a few beings of vision—'geniuses,' to use the humans' term—have arisen spontaneously. Their insights into the true nature of the Universe have inspired and led their less able fellows to new heights of scientific and spiritual development."

"Humph. Well, you paucimorphs can occasionally be a little clever."

The chaplain continued, "But I believe it's largely due to the great care they take in ensuring that what little knowledge they have is disseminated to and learned by as many of them as possible, particularly the young. That's the primary function of a certain well-respected class of humans. I don't understand the nuances of the different terms they use to describe that vocation—'teachers,' 'professors,' 'eggheads.' But their role is clearly vital.

"And there's another profession, the most revered of all, whose mission is even more crucial to improving the minds and morals of these humans. Their civilization produces a tremendous amount of worthless, even corrupting ideas and information. It's essential only the most important truths, the loftiest ideals, be filtered out from the falsehoods and temptations to sloth and ignorance assaulting their vulnerable brains. These professionals, the cream of their society, labor tirelessly to ensure that only the very best written and transmitted materials reach the masses. To them falls the critical task of selecting the fiction and fact best calculated to instill in their fellow beings the most inspiring ideas, the most felicitous beliefs and modes of thought."

"Sounds a bit analogous to what we Prime Movers do for you paucimorphs. What do the humans call them?"

"These noble, sagacious guardians of science and culture are known as 'editors.'"

Ch'klorb ceased vibrating for a long time. Finally yt rumbled, "Well, I suppose it wouldn't hurt to spend a few hundred cycles here and grant these natives Revelation. The crew will have to work double shifts at our next mining job to make up for lost time. But that's a small price to pay for my being worshipped by these deserving creatures. Tell the chief pilot to change the *Omnivore*'s destination to—what did you call their planet? Dearth?"

"Close enough. But going to their planet would be the worst possible thing we could do!"

Startled, the Prime Mover accidentally rolled over the smaller probe, crushing its antenna. "*What?*"

"Let me show you why we shouldn't go there."

More images appeared. A group of humans sat in a large chamber, gaily watching moving pictures projected onto a rectangular screen.

Suddenly a darkly handsome figure oozed into the chamber. Yts pulsating amorphous bulk followed the humans as they ran screaming from the "movie theater," absorbing everything in yts path before congealing into a colossal, majestic globular shape.

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The chaplain said, "Notice how the humans react in this particularly prescient vision of the Coming of the Prime Mover. Even when confronted by such a crude simulation of Your Spherehood, they feel themselves so unworthy to be near Yt they immediately flee in abject humility—some actually falling and injuring themselves in their haste to escape Yts awesome presence!"

Cailar thought the images into nothingness. "How much more violent would their reaction be if they were suddenly confronted by Your *actual* Divine Presence! Why, if You came to them now, they'd be overwhelmed by Your magnificence. Their minds and *khwazi* couldn't stand the strain. They'd either expire at Your base, immolate their bodies before You in ecstatic sacrifice, or lose their very sanity in Your glorious presence. And *then* who would be left to worship and serve You?"

"Good point."

"I thought you'd agree, Your Blobularity."

"My what?"

"I mean—Your Globularity."

"Well, if we shouldn't leave, or fly the *Omnivore* to their planet, what *should* we do?"

The chaplain smiled humbly. "Here's what I suggest. . . ."

Ch'klorb rocked nervously on the floor of the shuttle bay. "You're sure you have all the supplies you need?"

Cailar watched as several crewbeings loaded the shuttle. "Yes. I'm taking synthopatterns to make everything necessary to give the humans a Rating-2 spacefaring technology. Inertialess drives for interplanetary travel, and hyperspatial motors for longer trips. Genetic manipulators to cure all their diseases and injuries, and extend their youthful lifetimes indefinitely. Macrofabricators for constructing their spaceships, biomets to produce unlimited food and oxygen supplies on them, and Level-A force field generators to protect their ships. Once I teach them how to build their own large-scale synthecators and matter transmuters, they can create as many of these as I'll need."

The captain scanned one of the dataspheres a drone was carrying onto the shuttle. "Wait a nanocycle. That contains patterns for a superstring slicer and quark-blasting disintegrator beam. Only Rating-1 civilizations—the ones most devoted to the Great Masticator and Yts servants, like *me*—are allowed to have them. Too dangerous otherwise. One of those could even cut through my shell!"

"Don't worry, Your Sphereness. I'll supervise their use personally."

"But why do you need them?"

"The humans will require extensive training in practical planetary engineering techniques to become worthy tools for You. I'll start them off with simple projects, like making their two neighboring planets habitable and mining the asteroids between their fourth and fifth ones. But there's also something special I want them to do in Your honor.

"Their moon is a rather worthless place, its surface pitted with numerous craters like that small white ball I showed you. I'll have them use slicers and disintegrators to make it smooth and perfect, then transmute its outer layer to the whitest marble until it looks just like You. Hanging high in their night sky, it'll be a fitting, awe-inspiring monument to Your magnificence. Something they can gaze at and adore before You come in person."

"Well . . . that makes sense. But how long do you think it'll be before they're ready to receive me?"

"At least ten thousand cycles, Your Orbness. As I explained, they need a prophet like me to prepare Your way, to make smooth Your path until You come in glory. One of their legends describes a group of humans born deep in the darkness of a cave, manacled to its walls, never having seen the light of their sun. Just as thrusting them out suddenly into the full glare of its brilliance would only

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make them blinded and confused, so would seeing Your Ideal Form all at once do the same to these Earthians.

"But by my revealing Your Ineffable Nature to them a *little* at a time, over thousands of cycles, when You finally return they'll be ready to abase themselves in Your presence without being hopelessly dazzled, and able to joyfully follow Your commands."

The chaplain smiled. "Think of it. Billions of technologically-advanced sentients, all eager to do *Your* bidding. Ready and able to mine so much material for the Hypersphere in *Your* cause, the Elders will surely grant You a place in the First Rank!"

The crew finished their work and left the shuttle. Ch'klorb extended a pseudopod and petted the paucimorph's head fondly. "Good luck, Cailar. You've been a good and faithful servant, and I'll miss you."

"Farewell, Master. I'll miss You too. And if You believe that, there's a bridge in Brooklyn I'd like to sell You."

"What?"

"A human colloquialism. It means someone wishes to give another an object of great value."

The captain raised a pseudopod over Cailar in benediction. "May the Great Masticator make your rolling easy."

The chaplain bowed his head solemnly. "Screw you," he prayed. "*That's* an expression humans use to declare their deepest feelings for each other."

As his shuttle sped towards Earth, Cailar watched the holoimage of the *Omnivore* dwindle on the viewscreen. Once in orbit around the planet he'd broadcast a message to the humans, describing the technological wonders he was bringing them.

Naturally, they'd be suspicious of "Greeks bearing gifts." But he knew their curiosity and greed would prove stronger than their fears. After the shuttle landed in Washington and they'd taken him to their leader, the rest should be easy. Even if the humans stupidly refused his offer to lead them on a crusade to liberate the Galaxy, stopping all of their world's electrical power for thirty minutes should convince them cooperation was the best policy. And, remembering what else happened in that particularly interesting movie he'd studied, he'd keep some technological tricks—like his personal force field generator and teleportation unit—to himself. Just in case they tried to "kill the goose that laid the golden egg."

Suddenly the *Omnivore* disappeared in a flash of hyperspatial distortion, carrying the Prime Mover and yts crew to their next mining job in some distant star system. Cailar pictured the captain rolling fitfully around the mothership many light-cycles away, impatient to return and receive yts rightful due from the inhabitants of this system. It was up to him to make sure the Prime Mover got the reception yt so richly deserved.

The ex-chaplain ripped the circlet of prayer beads from his neck, sending the tiny white spheres flying around the cabin. "And maybe," he hissed, "before you return, I and my humans will come looking for *you*."

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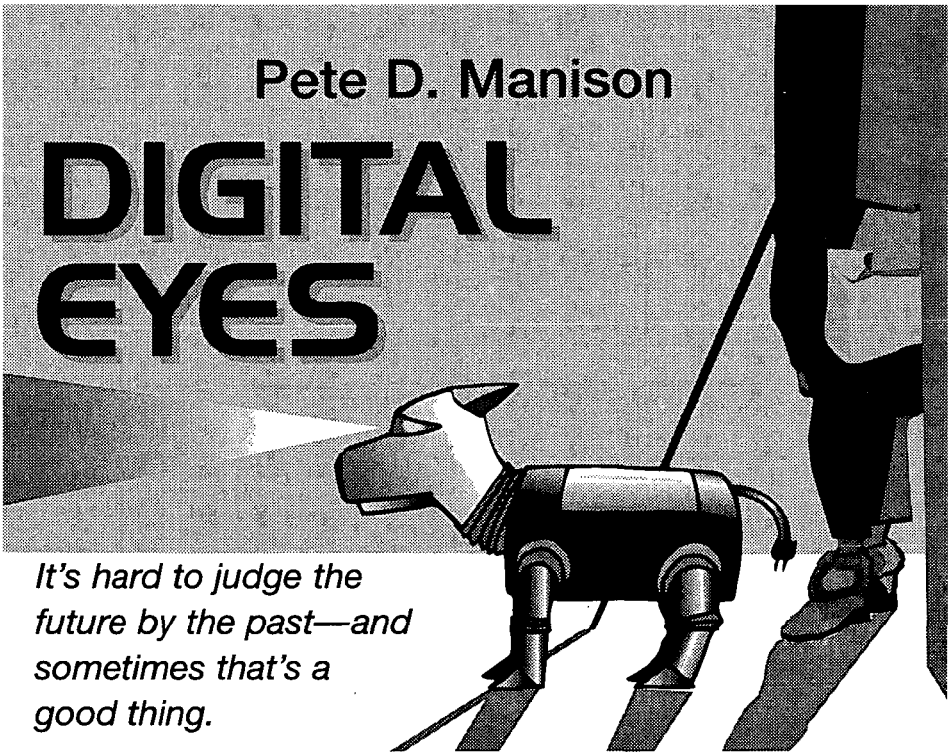
Pete D. Manison

DIGITAL EYES



It's hard to judge the future by the past—and sometimes that's a good thing.

You wake up and it's dark and you sit up in bed.

Pitch black.

You reach for the light switch and flip it on. There's a click. Nothing happens.

Then you blink.

You feel the stitches, there, when you blink. The pain's beginning to register now, too, and you reach up in the blackness with one hand to touch your face.

Your eyes are gone.

They have come in the night, and they have stolen your eyes.

You cry. Strangely, you can still cry, and real tears still come out. You can feel the warm wetness on your face. Or maybe that's blood from the empty sockets. You don't know for sure. All you know is that they finally got to you, and this is how it's going to be every morning for the rest of your life.

Dora woke up, the dream making her gasp as she sat up in bed. It was the same dream as always. There was never any variation to it. At least in my old age, she thought, I might become more imaginative.

But she never did.

"Digit?" Dora called. The little pest had taken a snooze himself, detecting no motion from her for a while. He was clever that way. He knew how to conserve his batteries for when she really needed him.

Sure enough, here he came. First a faint milkiness seeped into the blackness. Then it brightened slowly through twilight to full brightness. The little darling. Always so careful with her, so gentle. Always giving it the little extra touch.

"Digit, you're wonderful. Have I told you you're wonderful?"

Her own voice echoed off the walls of the apartment. Digit whirred and clicked as he scuttled out of his corner and balanced on his long insectile legs near the end of the bed. Seeing through

Illustration by Shirley Chan

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his lenses, she felt nine inches tall until Digit edited the images so that when she stood up from the bed she seemed to be looking out from about her own chest level. Her bedroom was a mess. Carefully picking her way between pieces of furniture, Dora went to the bathroom and washed her face.

"Market day, Digit. Aren't you excited? It looks like a fine day out, too."

Digit meandered to the window, showing her enough of herself to brush her teeth, but splitting the view so she saw outside too, saw a kid riding his bike down the street, saw a dog chasing a squirrel up a tree in the yard next door. She didn't get out much these days, what with her troubles, but it was always a nice way to start the morning.

The route to the market was through the seedy part of town, but so was the route to the post office and the doctor's and the laundromat. Dora kept Digit close so she could track the pedestrians well enough to keep from bumping into too many of them.

The image stuttered a lot going over bumps, of which there were plenty along the sidewalk. Dora paid it no mind. Far better than making this walk on her own, with only her cane to guide her.

"Pardon me," she asked at the crosswalk. "Is that light green or red? My Digit's a touch colorblind."

The man looked at her and quickly looked away. But he crossed the street, which meant it was safe.

Dora followed.

The alleys along here were littered with trash can lids and broken beer bottles. Her heightened sense of smell picked out every nuance: urine, at least a day old; rotting lettuce; the faintest touch of marijuana. She remembered how much the olfactory enhancement had aided her, back in the old days, how often it had saved her skin. Now it only served to remind her of how far behind her she had left that life.

Digit beeped.

"There's a good boy," she said. "The market—and in record time, too."

Now the scents of mangos and lemons and ground pepper came to the rescue. Digit helped her pick out the ripest tomatoes, though she had to squeeze them to be sure, and he saw to it that the cashier didn't shortchange her.

Another successful expedition.

Dora whistled as she walked back up the street toward her apartment. Digit liked it when she whistled, and he got a trifle feisty now, darting out ahead of her and spinning so she saw herself for an instant every revolution: an old woman dressed in black, a hood pulled over her face with a cane clutched in one shriveled hand and a brown paper bag in the other.

And two men stepping out of the alley behind her.

"Digit!"

Dora turned just as one of the men grabbed her right triceps and squeezed. The old instincts tried to drive her to defense, but her body was too old and too frail, and her Digit had been kicked into the gutter.

"Here, Digit!"

Her voice came out a strangled croak as one of the hoodlums pushed her back and she landed sitting down, her back pressing against a damp brick wall that had fungus growing on it. She felt her hood fall back, exposing her face, and she heard one of her attackers gasp.

"She's blind, you zero! You just beat up a blind lady."

"Shut up! I didn't beat nobody up. Quick, grab her eyebot!"

Dora's mind was snapping along, hyperalert. The first voice belonged to a boy, fourteen to fifteen years old, a little overweight, and more than a little frightened. It sounded like he was from the north side, by his accent and his use of the word "zero."

The second voice was sharper, yet more calm. In control. A couple of years older, this one, leaner and more fit. Digit

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caught that last bit as the boy bent over to pick him up with two long, well-muscled arms. The image stopped at the shoulder, though. She couldn't see his face.

Footsteps on wet pavement. The hoodlums were departing down the street, back toward the market.

It had started to rain.

Dora got up, straightened her cloak, and pulled the hood back around her face. She appraised her injuries, decided she would live. Then she reached into a hidden pocket in her cloak, withdrew her cane, and telescoped it out to its full length. She picked up the bag from the market. Three tomatoes had fallen out and rolled several feet up into the alley. She collected them. Then, resuming the tune she had been whistling earlier, she began to make her way along the sidewalk to her apartment. She found the potholes with her cane—most of them, anyway.

And all the while, images from the captive Digit danced in her eyes.

The hoodlums had a bolthole four blocks away. Dora was able to gauge that by the strength of Digit's signal. Lucky for her they hadn't yet had the nerve to take the eyebot to one of their parents' homes: that would surely take him out of range, and if that happened, Dora knew she would never see him again.

Ha. Funny how the verb "to see" still came to mind after all these years. Now, of course, she *did* see. But not the single darkened room of her apartment, not the little mementos of a long and eventful life, jewels more precious than their mountings suggested. What she saw was a boarded-up space with rat droppings in the corners and a single bare glowstrip pasted haphazardly across the ceiling.

Marco and Chief were sharing a bottle of beer as they regarded their stolen eyes. She knew their faces now, and she knew their names—at least the names they called each other. Marco was the pudgy one. Chief was the one who kept fiddling with Digit's controls.

Blue faces. Red. A background that shimmered and flowed like water. Then he killed it completely, just for awhile, and there was darkness.

Dora thought about calling the police again. Maybe her fake ID would hold up; maybe they wouldn't even check. Maybe they'd just go and get Digit and bring him back to her and then throw the two little punks into Juvenile Detention where they belonged.

Maybe.

And maybe not.

The not worried her a lot. She had so much to lose if they found her, if they did a gene-check and traced her true identity.

No.

Another Digit? She couldn't afford that, not on the monthly check she received from an anonymous source. And besides, she'd grown kind of attached to the little guy. To replace him seemed . . . heartless.

So she watched the images carefully when Chief got it right and Digit could see again. She focused her awareness as she had in the old days, squeezed max data out of every pixel the eyebot transmitted, out of every syllable uttered by the two boys.

In an hour she knew just where they were and how to reach them.

An hour after that, she was polishing up a few of her mementos, but only the ones she would need.

Outside the building, Dora sat on a bench for ten minutes. Standard Operating Procedure. Dressed in a yellow rain slicker and holding an umbrella, she sat right next to the entrance, making sure plenty of people saw her. What they saw—or what they thought they saw—was a man, aged forty, with distinctive cheekbones and eyes that met their own for a brief but memorable instant.

The first, the appearance, she managed easily enough. The second, the

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looking people in the eyes, was a greater challenge. She judged height from the sound of their footsteps, distance and direction by the sound of their breathing. The witnesses would describe her as a perfectly ordinary-looking forty-year-old man with blue eyes, a yellow rain slicker and a black umbrella.

Dora chuckled. It had been a long time, but the old skills were returning. She got up from the bench and entered the building. She greeted three people, all of whom would remember her as a polite forty-year-old man in a wet yellow rain slicker. First in the elevator, and then by the maintenance staff when she got off at the lowest sub-basement. Two more witnesses would remember her, in their translated testimony, as a forty-year-old technician of some kind, male, wearing a white uniform shirt and carrying a small black toolbox.

And on, to the opening of a service crawlway that led down to the building's processing engines, buried deep in the earth. She used her cane to move between pieces of machinery and dangerous pieces of protruding metal. Here, she knew she would find the room with the pipes and the ventilation conduits and the single bare glowstrip fading on the ceiling.

"Good Digit. Good boy."

She encountered no one else on the way down. Between the two processors she moved, then deeper beneath the building and into the drainage system. The largest pipeline—there. The one from the images.

Dora dropped all her personas now and went in as herself. She wanted to be herself for this.

"You little bastard! You drank it all!"

"No I didn't! You're the one that spilled it!"

Digit sat immobilized on top of a used shipping crate that served as a table. The boys were wrestling out of sight to the right, but once every few seconds a thrown object would fly across the tiny room. One empty bottle missed Digit's eyes by inches.

If they broke the lenses . . .

No. Dora didn't let urgency prevail over cold reason. She never had during her entire Active Duty Period, and her mind had grown, if anything, more dominant over the drives of her flesh in these later years of life.

She waited, ignoring the ache in her knees that came from crouching in the damp pipeline.

And waited.

The boys arm-wrestled. Then they found another half bottle of something and Chief drank most of it, leaving only a gulp for Marco.

They sang a little song to Digit. Chief removed the eyebot's feelers and tossed them onto the pile of components that already contained his legs and backup battery pack.

And Dora waited.

She waited the way she had waited in the jungles outside São Paulo once, the way she had waited in zero-*g* one of the times her employers had sent her into space. And other times, always the same—the same patience, the same clear perception of what she must do.

At last the boys got tired. They took turns urinating into an empty paint can in the corner, and then they fell asleep, fully within Digit's view.

Dora moved, at last, from the place where she had hidden.

"Rise and shine, boys. The party's over."

Dora stepped out through the rough opening they had battered through the ancient brick wall. She stood beside Digit, but she kept her awareness focused on the two boys, no matter how loudly a part of her cried out to care for her crippled friend, to do what she could to repair the damage.

"What the. . . ?"

Marco sat up first, wiping from his face what her amplified olfactories iden-

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tified as an equal mix of stale beer and sweat.

Chief stirred a moment after Marco. He had consumed 1.75 times as much alcohol as Marco, and she silently took this into account as she estimated his reaction time.

Digit sent a clear image of both of them, but that would change when they moved.

She was ready.

"Shit! It's that blind lady you kicked!"

"I didn't kick her! Shut up!"

Chief was rubbing his eyes. Marco had already started edging toward the exit, but she was blocking it and he stopped within easy striking distance.

She struck.

Marco crumpled to the floor, a loud crack coming from his knee the instant before he shrieked in pain and fainted. Dora had already turned on Chief, but the scrawny little fellow was quick. He was gone, out of Digit's field of view.

"What the hell did you do that for? What are you doing here, anyway?"

She locked on the voice and whirled, and in the same instant she drew the force-club out of a hidden pocket, switched it on, and hit Chief in the side of the head. He grunted, and she heard him fall, but then came the scuttling sound that meant he was still conscious and trying to get to his feet.

"Who are you?" he screamed. "You're supposed to be blind!"

Marco was stirring thirty degrees to her right. She heard him get to his feet, trying his best (poor lad!) for silence. Dora didn't stop him when he bolted for the exit, though she easily could have.

He wouldn't talk. Fear would see to that.

Instead, Dora used the distraction of Marco's departure, used the split second when Chief's breathing told her he had turned his head, to lunge for Digit. Triangulating on the image-source, she miscalculated slightly and almost dropped him, but by the time Chief turned back she had already rolled to the corner furthest from the glowstrip and come up with Digit in one hand and her stun-wand in the other.

There Chief stood, blood oozing from his right ear, his face pale and bloodless but his fists balled up in rage.

"This is our place," he said, a plaintive note creeping into his voice. "You're busting it all up."

Dora laughed. He was just a boy. "So," she said, "you thought it would be funny to steal a blind woman's eyes."

Chief gulped. She saw him think about following Marco, but from where she'd positioned herself he would make an easy target. She saw him realize that in the same instant he realized what trouble he had found.

"Hey, look, we was only fooling. You got the 'bot back. You got him back."

"But look what you did to him." She wanted to scream the words, to vent all her sorrow for Digit and her loathing for the punks who had done this to him. She didn't, though. Her voice came out icy cold.

Now Chief's eyes were open wide, cutting through the pain. He bent over to pick up a broken beer bottle. "If you think I'm gonna let some old lady—"

He never finished the sentence. Dora broke his hand around the bottle, the splinters of which drove themselves into his palm and three of his knuckles. Then she tapped him with her stun-wand and watched him collapse to the floor.

The rest took no time at all. He was waking up again by the end of it, but it was far too late for him by then. His single free hand reached up to touch the facial harness. Dora saw the precise instant when he understood, when he knew.

"Please," he sobbed. "You gotta let me out of here. I gotta get out of here."

Dora smiled. She picked up the control unit and placed a single finger on a single button.

"Oh, no. You can't. You won't. I got money. I'll pay you anything. It was Marco's idea. Oh God oh God lady please

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I'm sorry what I done we was only fooling around I gotta get out of here!"

Dora remembered other men pleading, all too often during her long career—pleading for their lives, for the lives of their children, for their fingers or their faces or what hung between their legs. She'd never flinched, never weakened, though the naked fear on their faces always burned as much as it excited.

She had served her masters well. She had always done what was necessary. Even a competent assassin did that. And she had been far more than competent.

A week later, Dora took Digit for a walk. His new chassis still had a few glitches, but Dora would work them out in time. As they walked up the street to the market, she whistled. Digit darted up ahead, still wobbling on uneven terrain, but she encouraged him.

"Good boy, Digit. You can do it."

The doctor, an acquaintance from the old days, hadn't asked questions. He'd performed the surgery well. There was only pain when she squinted, and even that was fading fast.

She'd forgotten how blue the sky could be.

"Look out, Digit!" she called.

He turned to whistle back at her and didn't look where he put down one foot. It settled into a hole in a metal sewer cover, and he went down.

"Digit!"

Dora raced to his aid, ignoring the curious stares of several passers-by. They had all known her as The Blind Woman, after all, and to see her tearing down the street after her eyebot had to be at least a little unsettling. But Dora had eyes only for Digit, whose leg she carefully extricated from the manhole cover. She checked it, pronounced it unbroken, and set Digit back on the ground.

"It looks fine to me," she said. "Just watch where you're going, will you?"

Digit beeped a happy response, and Dora resumed her walk to the market, whistling in the light of the morning sun. ■

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THE MICRO-WARP DRIVE

A recent breakthrough has moved the concept of a "warp drive" another step along its path from a fictional SF prop-idea to a well-founded physics concept that might one day be realized. This improvement on the Alcubierre warp drive was devised by general relativity theorist Chris Van Den Broeck of the Catholic University of Leuven in Belgium. Seemingly insurmountable problems with the Alcubierre warp-drive scheme have been eliminated by Van Den Broeck. His improvement employs topological gymnastics to keep the interior of the warp bubble large while making its external surface very small. But before describing Van Den Broeck's work, I'll summarize the Alcubierre warp drive concept itself, first featured in my column (#81) in the November '96 *Analog*.

Until 1994 a "warp drive" was one of the myths of science fiction, a rubber-science concept used principally to permit space opera heroes to flit from one star system to another at faster-than-light speeds, moving the plot forward in the process. Those familiar with the laws of physics saw the warp drive as a flagrant violation of the principles of special relativity, conservation of energy, and physics-as-we-know-it. It was tolerated as an excessive, but perhaps necessary, use of literary license by SF authors.

The status of the warp drive changed dramatically in 1994, when Dr. Miguel Alcubierre published a paper entitled "The Warp Drive: hyper-fast travel within general relativity" in the journal *Classical and Quantum Gravity*. Alcubierre is a theoretical physicist from Mexico who in 1994 was working at the University of Wales and is now at the Albert Einstein Institute in Potsdam, Germany. Also a fan of SF, he was steeped in the SF tradition and turned his physics expertise to the task of considering how a warp drive might be constructed within the restrictions of general relativity, our present "standard model" of gravity. Alcubierre constructed a "metric," a mathematical specification of the curvature of space-time that had all the characteristics of an SF warp drive including the capability for faster-than-light travel. Surprisingly, Alcubierre's warp drive metric is a solution of Einstein's equations of general relativity and is completely consistent with them. Science fiction's warp drive had been given a consistent theoretical and mathematical basis.

When theoretical physicists use general relativity, their normal procedure is to start with some distribution of massive objects and to calculate the metric describing space-time curvature that such a distribution would produce. Alcubierre reversed this procedure. Without worrying about how it might be formed, he constructed a metric that could transport a volume of flat space, perhaps containing a spaceship, at superluminal speed. This was accomplished by placing the volume of flat space inside a "bubble" of highly curved space, then destroying space in front of the bubble while creating new space behind it. Effectively, the warp bubble is

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driven forward by creating and annihilating space as if a local Big Bang were occurring at the rear of the spaceship while a local Big Crunch was occurring in front of it.

How does Alcubierre's metric manage to move an object faster than the speed of light? Isn't that in direct contradiction to Einstein's special theory of relativity? Actually, no. General relativity treats special relativity as a restricted subtheory that applies locally to any region of space that is sufficiently small that its curvature can be neglected. General relativity does not forbid faster-than-light travel or communication, but it does require that the local restrictions of special relativity must apply. In other words, light speed is the *local* speed limit, but the broader context of general relativity may provide ways of circumventing this local statute. One example of this is a wormhole (see my AV columns, *Analog* June 1989 and May 1990) connecting two widely separated locations in space, say five light years apart. An object might take a few minutes to move at low speed through the neck of a wormhole, observing the local speed-limit laws all the way. However, by transiting the wormhole the object has traveled five light years in a few minutes, producing an effective speed of a million times the velocity of light.

Another example of a faster-than-light phenomenon is the expansion of the universe itself. As the universe expands, new space is created between any two separated objects. The objects may each be at rest in their local space-time, but nevertheless the distance between them may grow at a rate that is much greater than the speed of light. According to the current standard model of cosmology, most of the universe is receding from us at FTL speeds and therefore is completely isolated from us.

Alcubierre's metric uses an analogous expansion of space to drive the warp bubble forward. However, since the ship within the bubble is at rest in its local space, the occupants will feel no acceleration forces when the forward speed of the bubble changes, nor will they experience the "usual" relativistic effects of mass increase and time dilation. If an Alcubierre warp-drive ship travels 100 light years at 100 times the velocity of light, to both the occupants and outside observers the trip takes one year, no more and no less.

Alcubierre's publication stimulated a flurry of activity among general relativity theorists, who investigated the implications of the new idea. It was found, by himself and others, that Alcubierre's original warp-drive idea had a number of serious problems. It violated the strong, dominant, and weak energy conditions of general relativity. The net energy of the warp bubble, as it turned out, was extremely large and negative. For example, a warp bubble 100 meters in radius that might contain a spaceship of reasonable size would have a net negative energy that was roughly ten times larger in magnitude than the entire (positive) energy of the visible universe. Another problem was that the walls of the bubble would have to be so thin that they could not be constructed with matter, even "collapsed matter" of nuclear density. It was also found that most of the warp bubble is disconnected from a sizable part of the external negative energy region. Therefore, the surface part of the bubble could not be carried along and would have to be continuously generated externally. The drive could not be self-contained or self-operated. These problems have seemed so overwhelming that recent attention has been focussed on alternatives like the Krasnikov Tube (see my column #86 in the September 1997 *Analog*) that might present fewer problems of implementation and control.

Now, however, Dr. Van Den Broeck has proposed an improvement on Alcubierre's scheme that appears to solve many of its problems. Van Den Broeck

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observed that most of the undesirable effects of Alcubierre's drive scale were with the volume or surface area of the warp bubble. Therefore, his simple solution is to make the radius of the warp bubble so small that the problems go away. In doing this, he makes use of another trick from general relativity. The interior volume of a region of space bounded by a closed surface, because of space curvature, can be made much larger than the flat-space volume bounded by its surface. In curved space the inside volume of a sphere of radius R can be much greater than $^4/_3\pi R^3$.

The new metric of the Van Den Broeck /Alcubierre warp bubble is like a bull's-eye target with a center (Region 1) surrounded by three concentric rings (Regions 2-4). The central sphere in Region 1 is flat space large enough to hold a spaceship. Region 2 is a spherical shell containing distorted space that connects the large interior volume of Region 1 to an exterior region that is smaller in radius by a factor of $1/\alpha$. Region 3 is a transition region of flat space, a spherical shell with a volume much less than that of Region 1. Region 4 is a spherical shell that is Alcubierre's warp bubble, but now with a very small radius. Van Den Broeck makes the radius of Region 1 about 100 meters, and sets α to 10^{34}, so that Region 4 is only about 3×10^{-32} meters in radius. With such a small radius, if the warp bubble travels at 10 times the velocity of light the amount of negative mass-energy it would require is only about -0.06 grams. Even if it travels at 100 times the velocity of light, it would require is only about -56 kilograms of negative mass-energy. Region 2, where the volume of space is compressed from inside to outside also requires a quantity of negative mass-energy, but Van Den Broeck calculates that it is only about -4 grams. These small quantities of negative energy eliminate many of the problems of Alcubierre's original concept.

However, even with these improvements, there would still be very severe "engineering problems" with any implementation of the scheme. First, although the interior of the warp bubble may be quite spacious, its exterior is only 3×10^{-32} meters in radius, much smaller than a proton and approaching the Planck length (1.62×10^{-35} meters) in size. This is close enough to the minimum length-scale of the universe that such a size reduction is doubtful due to quantum effects. Moreover, since the diameter of the warp bubble is many orders of magnitude smaller than a wavelength of visible light (about 4×10^{-7} meters) there would be no possibility of seeing out from inside the bubble. Any trip would be a blind one, with no possibility of seeing or steering. Moreover, while the magnitude of energy required to form a warp bubble becomes more reasonable in Van Den Broeck's warp drive, the energy density requirement remains unphysically large.

And how could our space travelers enter the bubble or exit again at the end of their trip? Van Den Broeck's calculations indicate that slowing the bubble to a near stop might permit it to be expanded to any desired size. However, such an expansion would decrease the wall thickness, and it is not clear what would happen if the wall thickness became smaller than the Planck length. Van Den Broeck ends his paper by commenting that while the first warp-drive space flight remains a long way off, perhaps it has become slightly less improbable with the new scenario for a warp bubble.

From the point of view of science fiction, even the application of general relativity to create a volume of space that is larger on the inside than on the outside is very appealing. It would, for example, solve the book storage space problem for many of us. Further, I cannot wait until this principle is applied to airplane seats!

Van Den Broeck's warp drive is a large

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ANALOG
SCIENCE FICTION AND FACT

CONGRATULATES

THE WINNERS OF THE 1998 HUGO AWARDS

Best Novel
To Say Nothing of the Dog
Connie Willis

Best Novelette
"Taklamakan"
Bruce Sterling
Asimov's, October/November 1998

Best Related Book
The Dreams Our Stuff Is Made Of: How Science Fiction Conquered the World
Thomas M. Disch

Best Professional Editor
Gardner Dozois

Best Dramatic Presentation
The Truman Show

Best Fan Writer
Dave Langford

Best Fan Artist
Ian Gunn

Best Novella
"Oceanic"
Greg Egan
Asimov's, August 1998

Best Short Story
"The Very Pulse of the Machine"
Michael Swanwick
Asimov's, February 1998

John W. Campbell Award for Best New Writer
Nalo Hopkinson

Best Fanzine
Ansible

Best Semiprozine
Locus
edited by Charles N. Brown

Best Professional Artist
Bob Eggleton

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Michael A. Burstein

THE QUANTUM TELEPORTER

*Whatever happens is **ipso facto**, possible. So if your theory says it isn't, you're clearly overlooking something. . . .*

Illustration by Randy Asplund

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The phone call came in near the end of the day, when I had already donned my blazer and was thinking about what I wanted to make for dinner. I normally might have let my voice mail take it, but all I was doing was paperwork, and any distraction was welcome.

"FBI, Special Agent Drew Cutter speaking."

"Drew, hi. It's Jon Andover."

Some distractions are more pleasant than others. Jon was an old friend of mine from my college years, although we didn't go to the same school. When I was studying Physics at Harvard, he was learning esoteric computer stuff at MIT. We met through a mutual friend with whom we had both lost touch, but Jon and I tended to stay in touch by email once a month. Currently he was a scientist at the MIT Media Lab, working in their news of the future division.

"Hey, Jon! How's the world of personalized electronic newspapers?"

"OK, I guess. How's the world of strange science?"

I laughed. After college, I had gone as far as a Master's before deciding that research just wasn't for me, and I ended up in the FBI. In turn, the bureau had put me to use in scientific investigations—or rather, investigations involving government laboratories and other such things. My division was called Special Investigations. The work was interesting, but usually quite prosaic.

"Not as strange as you might think. What's up?"

"Well, something's happened here that I thought might interest you. Do you remember Nathan Gerber?"

"Barely." Gerber was a professor at the Media Lab, in charge of their physics division. I had met him once when I applied to do graduate work in his program, and had been turned down. I still remembered vaguely what he looked like—dark curly hair, glasses, and a beard. But I wouldn't recognize him if I passed him on the street.

"Well," Jon said, "he's dead."

"Oh," I said. I wasn't quite sure how I was supposed to react. "What was it?"

"Well, that's part of the reason why I'm calling. The Cambridge police think it was a suicide, open-and-shut."

"Um. And you have reason to think otherwise?"

"Yeah." He paused for a moment, then said, "I think that it might have been murder."

"Murder? Why would anyone murder Gerber?"

"I'm not sure, but it may have had to do with his research. That's why I think you might want to come investigate."

I leaned back in my chair and loosened the knot in my tie. "I don't know, Jon. Even if it is murder, that's not usually the FBI's jurisdiction."

"Oh, I don't know about that. I think there's something more going on, something right up your alley."

I turned on my tape recorder. "So tell me. What was he working on?"

"Do you remember that article you told me about a few years ago over lunch? The one on quantum cryptography?"

I nodded. "I remember. I actually read up on it because of Gerber. He seemed very enthusiastic about it, and I was hoping to impress him."

"Well, do you remember telling me that quantum cryptography could lead to teleportation?"

I laughed. I remembered how animated I had been during that conversation, claiming that teleportation was just around the corner. I felt a little more sedate about the possibilities now. "Well, yeah, sure, of photons and things like that. That group at the University of Innsbruck led by Anton Zeilinger managed to do it in 1997."

"Well," Jon said, "it's not just limited to photons anymore."

I started drumming my fingers on the desk. "Uh-huh," I said. "What are you talking about?"

"Gerber cracked the teleportation

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problem when it comes to matter."

"Do you mean to tell me," I asked, "that he had actually succeeded in putting the theory into practice?"

"Well, he had just done a demo for the government. How's that for practice?" At most academic laboratories, researchers had to "publish or perish," meaning that if you didn't publish your results your career would go nowhere. At the Media Lab, on the other hand, the saying went "demo or die." If you wanted funding, you had to demonstrate that your research would have valuable applications in the near future.

"Jon, are you sure you're supposed to be telling me this?"

He laughed. "You have clearance, don't you?"

"Of course I do. But I still don't see why you think this might be an FBI matter."

"Well, I thought you might be interested in checking out the murder scene—I mean, the room where he was found dead."

I was confused. "Because of the quantum cryptography connection?"

"No, because the room he was found in was locked."

I laughed. "You're kidding, right? Oldest cliché in the book. And I can see why the Cambridge police thought it was suicide. That makes the most sense, if he was found in a locked room."

"But, Drew, remember. He was working on teleportation."

I nodded. "Ah. So you think that the murderer teleported into the room, killed Gerber, and then teleported out. If there even was a murderer," I added.

"Well," Jon said, "it's a little more complicated than that."

"How?"

"Ah," said Jon, and I could almost hear the smile on his face. "Gerber was found in an experimental Safe Room. It's lined with a material that's opaque to teleportation."

I let the silence on the phone linger for a moment, then said, "Opaque to teleportation?" That didn't seem possible, given what I knew of the theory.

"Yes."

"And you still have good reason to think it was murder?"

"Yes."

"I'll be there tomorrow."

It took a bit of discussion to convince Rachel Rotstein, the head of my division, to let me go, when I explained about the teleportation experiment. She didn't really believe it, even when I pulled a few articles on quantum cryptography out of the files, including the one that Charles Bennett and company had published in *Physical Review Letters* in 1993.

"Is there really something here worth investigating?" she asked.

I nodded. "I really think so. And if there is anything to this teleportation experiment, the folks over at the Engineering Research Facility might find it of interest." One of our jobs was to help out the Technical Support squads by tracking technology that might help them develop even better tools for surveillance. The ability to teleport a bug, or even an agent, might be useful.

Rotstein looked thoughtful for a moment, then nodded her approval. "All right," she said. "Let me know what you find."

I flew from Washington, D.C., to Boston the next day. It was the middle of the summer, and Boston was suffering from its usual humidity, accentuated by a national heat wave. It made wearing a blue blazer and tie very uncomfortable, but I had to look professional.

The Boston field office is on the ninth floor of the JFK Federal Office Building in the downtown Government Center area. I took the subway there, checked in with them, arranged for a car, and then headed to the Cambridge Police Department in Central Square. I showed them my credentials and asked to see the file on Nathan Gerber. They were helpful, but surly, which one of the offi-

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cers explained by pointing out that I was investigating a case they had already closed.

I sat in one of the empty offices and read the file. It was minimally informative. Nathan Gerber, 42, was found seated in a locked room in the MIT Media Lab. A bullet had gone through his brain, splattering blood and tissue onto the floor and wall. The handgun that fired the bullet was found on the floor, under his right hand, with his fingerprints on the trigger. Despite the lack of a note, the coroner had declared it a suicide, and life had gone on.

It seemed fairly open-and-shut to me as well, except that there didn't seem to be any motive behind the suicide. The police had interviewed the people in Gerber's life, including his graduate students, his colleagues, the lab director, and his wife, and nothing seemed to indicate depression or any of the classic symptoms of suicide. Gerber's autopsy had also shown him to be free of drugs or any sort of intoxicants. It was if he had just decided for no reason to sit down in his lab and blow out his brains.

Which probably explained why Jon was suspicious.

I made copies of the files, thanked the police for their help, and drove to MIT. I parked in Kendall Square and walked over to the Media Lab.

The Media Lab is a fascinating place, both in its architecture and its mission. It was founded in 1985 as a place where scientists could study the connection among three disciplines: broadcasting, publishing, and computers. If product development was any indication, the lab was pretty much a success.

Architecturally, the building looks like it was constructed out of large square bathroom tiles, both outside and inside. It had reminded the MIT community so much of a bathroom that they often referred to an outside arch of the building as "the toilet paper holder." Some wags once even added a sign that said, "Press here for a new roll."

I entered the building, and headed upstairs by elevator to Jon's cramped office. The labs and offices inside are all on four long corridors, which form a square. I found Jon's office and looked through the window. He sat amidst piles of papers, working on a computer terminal. Every surface in the room had a pile of papers, including the top of his monitor. So much for the paperless office we had once been promised.

I knocked on the door. He stood up, saw me through the window, and came over to the door to let me in. "Drew!"

"Hi, Jon." We shook hands, and I felt slightly intimidated for a moment. I'm not a small person, but Jon is tall and thin, and I always have to look up at him. Fortunately, his mild manner always offset his appearance.

We caught up with a bit of chitchat and then I asked if I could see what he was working on.

"I thought you might," Jon said, and sat me down in front of his monitor. "I've been working on a new algorithm for generating personal newspapers. Take a look."

The screen displayed the front page of a newspaper. I noticed that the articles were mostly about scientific research and local affairs in Washington, D.C. Also, today's Doonesbury, Dilbert, and Rhymes with Orange comic strips were prominently featured in the center.

"I see you're running my preferences," I said. Jon had prepared a personal newspaper program for me a few years back, and I had given him a list of preferences for his files. For about six months, I would get articles from the AP wire emailed to me automatically when the program decided that they fit my interest profile. It was fun, but I asked Jon to stop when I found it became too much of a time sink.

"Not quite. I'm using a more advanced program, which teaches itself what to put in the newspaper. Basically, I fed it all the articles that were selected for you when you agreed to help out,

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and the program taught itself what you like to read."

"What about Doonesbury, Dilbert, and Rhymes with Orange?"

He smiled. "Well, those I put in by hand."

"Hm. You should tell it I've started reading Miss Manners as well. She writes some great columns."

"I'll note it for later."

"OK. Can we go see the teleportation lab now?"

"Sure," Jon said. I stood up and followed him out of the office.

"I'm looking forward to seeing the experiment, even if you do think Gerber was murdered," I said.

Jon stopped short and turned to face me. "That's a good point, Drew. Before we go down, there's just one thing you should know. I told Gerber's group that I had invited you to see the lab, but no one else knows that I think he was murdered. We should probably keep it quiet for the time being. As far as they know, you're just a friend of mine come to see the experiment."

"But if the experiment's secret—"

"Well, I did tell them you were with the FBI." He winked.

We took the elevators down to the basement, where the physics group had its offices and laboratories. Gerber's own office had been on the fourth floor, but he had been found in the lab.

The elevator opened up into a hallway, and after a pass through a door and a quick turn, we arrived at the physics and media group area. The place was a shambles, with equipment and wires scattered all about the large rooms. It took me a moment to realize that this was probably the normal state of the lab, and not due to the recent police investigation. In fact, the only evidence that something was amiss was a piece of leftover yellow police tape hanging on a door frame at the other end of the lab.

The only other person in the lab came up to us when we walked in, and Jon introduced us. "Drew, this is Glen Mitchell, who's a graduate student in the physics and media group. Glen, Drew Cutter, the friend of mine I told you about."

We exchanged greetings. I remembered Glen's name from the case file as the one who had discovered Gerber's body. Glen looked like a stereotypical physicist, even down to the long, pocketed white lab coat he wore. He was slight, thin, dark-haired, and wore glasses. He scratched his head and said, "Jon told me he had invited you by. I'm not sure why, though."

I shrugged, and said, "Professional interest. My background is in physics, and I once applied to work in your group."

Jon nodded. "Drew was the one who first told me about quantum cryptography. I was planning to invite him to see the device once the secret was out, but Gerber—well, you know."

"Yeah, I know." He turned to me. "What Jon isn't telling you is that it's unlikely Nathan would have let you in to see the QCT at all, but now that he's dead—" He gave me a wry smile, then looked embarrassed for doing so.

"QCT?" I asked.

"Quantum Cryptographic Teleporter."

"Can I see it?"

Glen corrected me. "Them, you mean, not it. We've got four of them, two out here and two in the Safe Room."

Glen pointed to two large electronic devices in the middle of the room, facing each other. We walked up to the one labeled QCT1, and I studied it. It looked like a big shiny metal box, easily ten feet on a side. The side facing us had a glass door in the middle, which led to an inner chamber lit by one lone ceiling bulb. The chamber was lined with wires and lenses. Next to the door was a console, labeled with a lot of esoteric letters and numbers.

"How does it work?" Jon asked.

Glen and I began speaking at the

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same time. "Well—" we both started, and then stopped.

"It's your device," I said to Glen. "You should probably tell him about it. I only know the theory."

"Why don't you tell him?" Glen suggested. "I'm interested in seeing how much you really know of the theory."

"Correct me if I get it wrong," I said, smiling. I turned to Jon. "What do you remember from our conversation over lunch a few years ago, about quantum cryptography?"

Jon shrugged. "Mostly your enthusiasm. I don't remember much of the details, just that you said it could lead to teleportation."

I nodded. "OK. The basic problem with teleportation was how to make a perfect copy of an object, given that it's impossible to completely know the quantum state of every single particle in an object."

"Right," Jon said.

"Well, what the paper showed was that even if you don't know the quantum state of any one particular particle, you could reproduce it somewhere else by entangling it with a particle whose quantum state *is* known. Then you transmit the entangled particle to a different location, and use it to reconstruct the old particle. Got it?"

"Um, no. How does one entangle a particle?" Jon asked.

"Hm. Well, entangling particles just means making their properties dependent on each other. Like in Pauli's Exclusion Principle, if you have two electrons orbiting a nucleus in the same shell, one always has to be spin up and the other always has to be spin down."

"And when you say you transmit the particle, is that by teleportation?"

I shook my head. "No. That's simply a way of saying that you send the particle to a new location by conventional means."

"So then what happens?"

"Well, then the particle you've sent has the information needed to become the particle that stayed at home. And here's the interesting part, which makes it teleportation and not duplication. The process of transforming the particle that was sent destroys the information contained in the original particle as it creates the new one. Bennett and company were studying the nature of transmitting information, not people and things, but the physics is essentially the same."

"Let me get this straight," Jon said, and he gestured with his hands. "You send a bunch of particles from here to there which contain within them information about an object. Then, as the object gets taken apart over here, it gets recreated over there?"

"Exactly."

Jon whistled. "It's the transporter!" he shouted, and Glen winced at the *Star Trek* reference. I almost did, too.

"Well, not quite," I continued. "You need to have both a transmitting station and a receiving station, and since we don't have faster than light travel—at least, not yet—you can't teleport someone faster than light either. You have to physically place a receiver where you want to go. Kirk and Picard would have to send someone out ahead of them first, by shuttlecraft, to set up a receiver."

As I was speaking, I had been glancing at Glen to make sure that he didn't want to correct me. During that last sentence, he looked as if he wanted to jump in, so I paused. But he didn't say anything. So I went on.

"In conclusion, as long as you've got a receiver sitting somewhere with which to reconstruct a pattern, you can teleport anything or anyone anywhere you want."

Now Glen chimed in. "Except through this," he said smugly, and he tossed over a small, ragged piece of gray rock. I barely caught it.

"What is it?" I asked.

"It's a mineral compound that Nathan created during our research. It com-

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pletely blocks the transmission of entangled states. He called it cavorite."

I turned the rock over in my hand; it looked and felt no different from granite. "How does it work?"

"Not sure; neither was Nathan. He created it accidentally when using the QCT on different samples, and we still hadn't gotten as far as figuring out why it does what it does. Our current working model assumes that it acts like two polarizing filters at right angles, so it blocks all quantum states from getting through."

"Hm." I handed the rock back to Glen, but he waved it away. "Keep it. We've got plenty of samples."

"OK, thanks," I said, slipping the rock into my blazer pocket. "So you really *don't know why the cavorite works?*"

He shook his head. "No, but we know that it does work. Which was all we needed to create *that.*"

Glen pointed to the metal door at the other end of the lab, with a red light bulb above it. "That's our Safe Room. The door and walls are made of steel, and inside they are completely lined with cavorite. When the door's closed, nothing can be teleported in or out."

I studied the door. "What about the gaps around the edges?" I asked, pointing.

"It's airtight. And the room can be locked from both the inside and the outside, with two separate bolt locks." Glen walked over to the door, and we followed. "Want to see it in action?"

"Sure," I said.

"OK. First take a look inside the Safe Room."

He pointed at the metal door again. I walked up to it and hesitated; yellow police tape hung off the side. "Are you sure it's OK to enter?"

Glen nodded. "Sure. The room's been cleaned up since—well, you know. The tape's just left over."

I pushed open the heavy door, which resisted quite effectively. From the doorway I could see into the room. Two other QCT devices, labeled QCT3 and QCT4, sat in the room with their own respective glowing consoles.

I backed out of the doorway, pulled the door closed and bolted it.

"So what are you going to do?"

"Let's see," Glen said. He looked around the room and spotted an old copy of the physics textbook by Halliday and Resnick, the one with the yellow and green waves on the cover, sitting on a lab bench. Glen picked it up and handed it to me; it felt as heavy as I remembered from college. "Write something in the book so you'll be able to identify it again."

I thought for a moment, then turned to page ninety-nine and wrote the name "Fermat" in the margin. I handed it back to Glen, who placed it into QCT1 and *fiddled with the console. Just below the* word "Destination" I saw a row of lights, above the numbers one through four. The light above the number three lit up.

"I'm going to try to teleport the book to QCT3. Watch."

He pushed a button, and the book momentarily flickered inside the chamber. "It's still there," Jon said.

"Yes. As you can see, it can't go to QCT3 with the door closed." Glen sounded like he was reciting from the script to a demonstration he had done before. "Drew, go open the door."

I did so, and Glen instructed me to stay at the door and keep my eyes on QCT3. "Jon, you keep looking at QCT1."

In the same instant I heard Jon say, "It's gone!" I saw the book appear inside QCT3. It didn't materialize slowly or anything like that; there was just a quick flicker, barely noticeable. First the device was empty, then it wasn't.

Glen cut past me to retrieve the book, then stopped short. He turned to me. "Why don't you go get the book so you'll know I haven't tampered with it?"

I walked into the Safe Room, gingerly opened the door to QCT3, and quickly brought the book back into the lab. I turned to page ninety-nine and found

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the name "Fermat" written in the margin in my handwriting. It had to be the exact same book.

I whistled. "Incredible," I said, and I handed the book back to Glen, who put it back on the lab table.

Jon turned to Glen. "Can this device teleport people as well?"

Glen looked thoughtful. "A person's just a collection of quantum states. Both Nathan and I went through the QCTs lots of times. Of course, we tested it on animals first."

"Wow," I said.

A gleam appeared in Glen's eyes. "Hey, Jon. Do you think your friend would like to take it for a spin?"

"What do you mean?" I asked, trying to keep from sounding too excited.

"I mean, how'd you like to go for a ride in it? Be teleported?"

I slid my hand slowly down the glass door. It felt cool. "Is it safe?"

"Is anything? If it makes you feel better, neither of us ever suffered any ill effects. Neither did the cats."

I glanced at Jon, who shrugged and nodded. "Isn't it illegal to experiment on humans?" I asked.

"It's not experimenting anymore; we know that it works. Besides, I won't say anything if you won't," Glen replied.

As illicit as it might be, the truth was, I very much wanted to try the QCT. I did have one worry—what if the device teleported me but not my (hypothetical) soul? Would I still be me, with the same continuing linear consciousness? I quickly dismissed my concern by remembering that the QCT worked by entangling *all* the quantum states of *all* the particles in my body. If I did have a soul with some sort of physical existence, it would have to be teleported along with the rest of me.

And if my soul wasn't physical, well then, there was no way the machine could damage it. Of course, "I" might end up no longer inhabiting my body, but I couldn't see logically how that could work.

So I agreed. After all, this was like someone asking me to be the next person to walk on the Moon.

I had been holding my breath; I exhaled and said, "OK, I'm ready."

"Great!" Glen opened the door of QCT1 and I entered it. Looking out the glass door, I could see Jon at my left and Glen on my right, fiddling with the console. Jon had an odd smile on his face.

"Ready?" Glen called through the glass.

"Ready," I replied.

And that was it. One instant Jon was to my left and Glen was to my right—

—and the next instant they had flipped around, and I was staring at their backs. "I'm here," I said, and they turned around and opened the door of QCT2.

"I didn't feel anything," I shouted through the door.

Glen opened the door and helped me out. "You shouldn't expect to. The QCT copies everything down to the pattern of your neurons as they had been last firing. You might get a little disorientated from the new sensory input, but even that is negligible."

"Still, it was incredible."

"Yes, it is," Jon said. "It's a shame Gerber won't be around to enjoy the accolades. He would have won a Nobel Prize for this."

"Yeah," Glen said. "I never expected him to commit suicide."

I pointed back into the Safe Room. "Was he really found in there?"

Glen nodded. "I was the one who found him. Place was locked from the inside, and I needed help from maintenance to get the room open. When we sawed through the inner bolt, we found Nathan slumped in a chair, gun in his hand and bullet in his head. It was a bloody mess, his brains splattered everywhere."

"Oh," I said. Glen's description pretty much fit what I had read in the case file. "Well, Glen, it was nice to meet you. Good luck with your work."

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"Thanks," he said.

Jon and I headed back to his office. He shushed all my questions until we were both seated behind a closed door.

"What was that all about?" I asked.

"What do you mean?"

"Why did you bring me here? Why do you think Gerber was murdered?"

Jon leaned back, smiling. "Tell me what you thought of Glen."

I paused. "You don't trust him."

"That's right. I didn't tell you this before, but he started in the news of the future group. And I caught him cheating one day."

"Cheating?"

"Yes, cheating. He stole another graduate student's idea and claimed it as his own."

"How?"

"He sabotaged the guy's demo so it wouldn't work, and then did it himself."

I shook my head. "This doesn't make sense. If the guy did that, why is he still here?"

Jon looked around, nervously. "Well, for one thing, the guy whose demo he sabotaged isn't around anymore. Quit the place suddenly when his research failed. And for another thing . . ."

"Yes?"

"The other thing is that I don't really have any proof that Glen cheated. I mean, I saw him late at night the day before Barry's demo, fiddling with Barry's equipment, but I thought nothing of it at the time. The two of them were working together. Or had been; I didn't realize that they had had an argument and weren't partners anymore."

"So why is he in the physics and media group now?"

"Takegari didn't like him either." Takegari was Jon's group leader. "Glen realized that, and after a while, decided it would be more productive if he switched groups."

"And now his group leader is dead," I said. "You know, Jon, murder is a far cry from sabotaging someone's demo."

Jon nodded. "I know, I know. But I can't shake the feeling that Glen is responsible. Gerber wouldn't take his own life; he was riding high on his research—just got a major grant, by the way—and he had a wonderful wife. I just can't see it happening."

"Anything else?"

"Well, I heard the cops talking. They didn't find powder burns on Gerber's hands."

I stared at him; that fact had been noted in the case file. "You just *happened* to hear this?"

"OK, OK, I *over*heard the cops talking."

"Uh-huh. OK, let's assume for a moment that you're right. Glen waits until Gerber has entered the Safe Room. Then, using the QCT, he teleports in with a gun, shoots Gerber—bang!—smack in the head, puts the gun in Gerber's hand, locks the inside bolt, then teleports out, no one else the wiser until the next morning."

"OK," Jon said.

"The scenario's not going to work if the room is lined with this cavorite stuff. Or is the cavorite a fake?"

Jon dismissed my solution with one word. "Nope. Gerber created it independently; he wouldn't have lied about that. And he arranged for the construction of the Safe Room himself."

I rolled my eyes. "So tell me, Jon, if Glen did murder Gerber, then how did he teleport into and out of a cavorite-lined room?"

Jon smiled. "You're the physicist, Drew. You tell me. Why do you think I invited you to see the lab?"

Jon and I went to lunch at the Legal Sea Foods in Kendall Square. I ordered the fish chowder and the Boston scrod, and we continued our conversation as we ate.

I explained to Jon that if I was going to do this properly, I would have to do a full murder investigation, and I wasn't sure there was enough evidence to war-

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rant it. "The problem is that the case is closed, and Glen doesn't fit the profile of a murderer. I have no reason to open this investigation."

"Can't you just barge in on Glen with your badge out and get him to confess?"

I gave Jon a sarcastic look. "You've been watching too many movies. I can't do that. We only flash our badges in crisis situations." I smiled. "You're asking me to roast-beef him."

Jon blinked. "I'm asking you to do *what?*"

"Roast-beef him." I took a sip of my Coke. "There's a legend about a New York City agent who thought the corner deli near the field office gave extra food or discounts to FBI agents. When the counterman brought him a regular size sandwich, he showed his credentials and said, 'FBI! More roast beef!'"

We laughed. "What you're saying," Jon said, "is that I'm asking you to hang around investigating, hoping that you might intimidate Glen into revealing the truth."

I nodded. "Assuming, of course, that he has something to hide. But I can't do it. I would need a legitimate reason to be snooping around. After all, the case is closed."

Jon smiled "Isn't the simple fact that a teleportation experiment is involved enough of a reason for you to investigate?"

I thought about it. "That certainly was my argument to come up here. Let me see if I can get a go-ahead to open a full investigation."

I pulled out my cell phone and dialed Rotstein's office number. She was in.

"FBI, Rotstein."

"This is Drew Cutter. I'm calling from Boston."

"Hello, Drew. Did you hook up with your friend?"

"Yes, I did," I said, looking right at Jon. "Which is why I'm calling. I'd like to open up an official investigation. There may be something going on here."

"Uh-huh. This isn't just an excuse to spend more time with your friend at bureau expense, is it?"

I could tell Rotstein was smiling; I feigned offense. "Of course not! There's actually two significant things of bureau interest here. The first is a possible homicide—"

"Which is not usually our jurisdiction, Cutter."

"I know that. But there's also the teleportation experiment itself."

She sighed. "You know, I've been going over those teleportation papers you gave me in more detail. Especially the articles on the Innsbruck experiment. Let me see if I can find—ah, here it is. Listen. 'In the quantum teleportation process, physicists take a photon and transfer its properties to another photon, even if the two photons are at remote locations.' Now listen to this sentence, Drew. 'What's important to emphasize is that this scheme doesn't allow physicists to teleport the photon itself—only its properties to another, remote photon.' It seems like they're just transmitting information, not actual particles. It doesn't seem to be for real."

"I know it's for real. I—" I stopped. Telling Rachel I had gone through teleportation myself would probably not be the best thing for me to do. If she thought I was lying, that wouldn't look good. And if she believed me, I might be reprimanded for taking the risk.

"It is for real," I repeated. "I saw a textbook being teleported. Think about the implications of what you just read. If you transmit all the information that makes up a particle onto another particle, so that the second is an identical copy of the first, *with no way to tell them apart*, then it's just as good as the original. And Gerber's group went from teleporting photons to teleporting matter. This is an extremely significant advance."

"I don't know, Drew. This sounds like you're chasing after scientific chimeras."

"Engineering division," I said, my subtle way of reminding her that anything I found might be of use in surveillance.

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There was a long pause on the other end of the phone. "OK," she finally said. "Drew, since you're a good agent, and you get results, I'll approve of your staying in Boston for another few days. But the possible homicide is secondary, as far as we're officially concerned."

"What about unofficially?"

Another pause. "Whatever logically comes of your investigation is fine by the bureau."

I nodded. "I'll report as soon as I have something to report."

"Bye."

I pushed the disconnect button and folded my cell phone closed. "So?" Jon asked.

"Looks like I'm investigating."

The bureau put me up in a cheap motel that night, and the next day, Jon put me in contact with the other two graduate students who had worked with Gerber. Both of them knew about the QCTs, of course, but they had been working on entirely different projects. One, a thin blonde woman named Teresa Martin, was developing a sensor array for musical instruments, so a computer could record a musician's exact movements and reproduce them on a specially designed instrument. The other, a Greek national named Andonios Pappas, was also working with sensor technology, to try to get computers to respond to human eye motion and brainwave patterns. Neither of them had much information that I could use.

My interview with the Media Lab Director also didn't help. He knew about Gerber's research, of course, and was extremely cooperative, but he had nothing to add to what he had already told the Cambridge police. He found it strange that Gerber would commit suicide, but he did hazard a guess as to what might have caused it.

"Perhaps he was worried about what might happen to his research," he said. "Some of the scientists who worked on the Manhattan Engineering District quit the field in remorse after the atomic bombs were dropped on Japan. Maybe Nathan was feeling an attack of remorse in advance." It was a lame idea, and we both knew it.

Even though I couldn't explicitly come out and say that I was investigating Gerber's death as a murder, I was able to establish that all three of them had pretty solid alibis. Most scientists I've met love to discuss their research with someone knowledgeable, and both Teresa and Andonios had no problem showing me everything, down to their lab notebooks. It was very easy to ascertain their whereabouts for the night Gerber was murdered, by asking questions about their experiments on those days and casually extrapolating my inquiries into the evening hours. As for the director, he had been in New York City for a meeting with some corporate sponsors the night Gerber died, and hadn't returned to Cambridge until after Gerber was found.

And anyway, none of them had any real motive to kill Gerber. In fact, both of his graduate students were worried about the state of their projects, now that their advisor was dead. From what the director told me, however, they would probably fold Gerber's projects into other divisions of the lab.

That left one last person to talk to, and it seemed a stretch to include her in the official investigation, but I did need to question her for the unofficial one. Right after lunch, I headed out to Ivy Street in the Boston suburb of Brookline. Gerber had lived in a large, impressive house, the kind that I definitely couldn't afford on an agent's salary. I went up to the door and rang the bell.

A short, dark-haired woman came to the door. "Yes?"

"Marisa Gerber?" I took out my identification and showed it to her. "FBI, Special Agent Drew Cutter. I'd like to ask you a few questions, if I may."

I always try to phrase my requests politely, because it's impossible to predict

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how anyone will react. People are rarely delighted to be questioned by the FBI, although it does happen. In my experience, though, there are three types. The first type get terrified, afraid that we've uncovered a major secret. The second type get openly hostile, whether or not they have anything to hide.

Marisa Gerber was of the third type, resigned to my presence and eager to answer my questions so I would leave. "Sure," she said in a reluctant tone. "Come in."

She closed the door behind me and indicated that I should sit on the sofa. The room looked immaculate, but she apologized for the mess. "Since Nathan died I haven't been myself." I made sympathetic noises.

She relaxed into a large easy chair which overwhelmed her small figure. Then she sighed and said, "This is about Nathan, I presume. The police already said it was a clear case of suicide, although I never would have expected it."

Her soft tones and gentle manner immediately reminded me of an old saying. This was a woman who wouldn't hurt a fly.

I nodded. "I need to know about Nathan's research, actually. Mrs. Gerber, what can you tell me about the work your husband was doing?"

"Not much. It wasn't really my field."

"What do you do?"

"I'm a clinical psychologist over at the Brigham."

I nodded. "Did your husband ever discuss his research with you?"

She looked away, a thoughtful expression on her face. "Not really. I knew about his sensor research, of course, and he did tell me about the teleportation boxes, but not in any great detail." She turned back to me. "Sorry I can't be of more help."

"Maybe you can. It's possible that you remember something, but you don't realize it. Tell me, did you ever meet his students?"

Her face lit up. "Oh, sure. Nathan liked to have his group over for dinner every now and then. Said it gave them a chance to get to know each other outside of the lab."

Bingo. "Mrs. Gerber—"

"Marisa, please."

"Marisa, it's possible that you may remember something from conversations with his students. When was the last time you saw them?"

"Last month. What would you like to know?"

I made a show of consulting my little notepad and asked her first about Teresa Martin, then about Andonios Pappas. She ended up knowing a little more about their research than she had thought, but there was nothing in her discussion that pointed to either of them as a possible murderer.

Then we got to Glen Mitchell.

"Oh, yes, the one who was working with Nathan on the teleportation stuff."

I nodded. "Did he say anything to you about the experiment that you can recall?"

She laughed. "He never really said much to me. Or to the others, for that matter."

"What do you mean?"

She looked around, as if the words she needed were floating somewhere in the room. "How can I put this? Glen always seemed so socially awkward. He would sit at the table and eat, but rarely participate in conversation, even when the subject of his research came up." She looked thoughtful for a moment. "He seemed to isolate himself."

"Really?"

She nodded. "When he excused himself once to go to the bathroom, he didn't come back for a long time. I went looking for him and found him in Nathan's study, looking at the wall where Nathan hung his degrees and honors." She smiled. "Gave him a scare, I'm afraid, but I got him to return to the table."

"Is there anything you can tell me about his research?"

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She thought for a moment. "Not the details, no. As I said, he kept his mouth shut throughout most of the dinner parties. But I got the impression that his work wasn't going anywhere."

"Why?"

"Well, it was mostly from Nathan. I asked about Glen when he first came over, because Glen didn't seem to fit in well with the other students. Nathan told me that he took Glen on out of a sense of pity. He said Glen hadn't gotten along well with his previous advisor, and just needed someone to show some faith in him. But . . . "

"Yes?"

She shrugged. "I don't know. It's just that from the way Nathan talked about Glen after the last party, I had a feeling he was on his way out."

"Why?"

She shook her head. "I'm really not sure. Sorry."

I asked Marisa a few more questions, then gave her my cell phone number. "Thanks for your time. I'd appreciate it if you'd contact me if you think of anything else."

"I will."

Just as I left, she said, "You know, I wish you were investigating Nathan's death, not his research."

I paused at the door. "Why?"

She glanced away. "Because no matter what the police tell me, I simply can't believe Nathan would commit suicide. He was never depressed, never angry, and had quite a lot to live for."

I nodded. "I'm sorry, Mrs. Gerber."

"So am I."

I could hear her sniffle as she closed the door behind me.

So after spending most of the day interviewing people, all I really knew was what I knew before. Gerber had no reason to kill himself, and only Glen Mitchell might have had reason to murder him, assuming Jon's suspicions were correct.

I decided to tackle the problem from a slightly different direction. Even if Gerber was murdered, there was still the question of how, given the circumstances of his discovery in a locked room. The key seemed to be the cavorite, so I decided that I needed someone to analyze the sample Glen had given me.

Unfortunately, the Boston field office was more used to investigating organized crime and bank fraud than rocks. They had no laboratory facilities for chemical analysis, as they usually forwarded any such requests to Washington. But I wanted this rock analyzed sooner rather than later, and since my investigation revolved around MIT anyway, I asked Jon if he knew anyone in the chemistry department.

He introduced me to Marilyn Lott, an acquaintance of his and a postdoc in geochemistry. When I explained to Dr. Lott that I was with the FBI and needed a sample analyzed, she looked amused and said, "I don't do forensics."

"Oh, it's not that at all," I said, and handed her the cavorite while Jon studied the posters in her lab. "I'd just like you to tell me what this is."

She turned it around in her hands, studying it. "Looks like granite."

"Yes, but—it's supposed to have some interesting quantum properties. I'm curious about its chemical composition."

She shrugged. "Why not? I'm in a lull here anyway." She went over to a lab table, chipped a few pieces off the rock, and handed it back to me. "I'll call you at Jon's office in an hour."

As we turned to leave, a thought occurred to me. "One more thing. Could you analyze the crystalline structure as well?"

"I suppose. It'll take a little longer."

"Thanks."

Jon and I returned to his office, and I played with his personal newspaper program while he worked on other things. When the phone finally rang, he answered it, then passed it on to me.

"Yes?"

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"I finished the analysis of the sample. It appears to be a mixture of quartz and feldspar."

"Which means?"

"Granite." She laughed. "Sorry, I couldn't resist. But you were right to bring it to me.

"Why?"

"Well, it's not just quartz and feldspar. There's something else mixed in with the usual minerals, so it's not the ordinary, garden-variety granite."

"What makes it different?"

"There seems to be an abundance of silicates of aluminum, and something else I couldn't identify as of yet. If it helps any, it does seem to have a slightly higher density than usual. That may be important."

"I see," I said, and I took the cavorite out of my pocket and examined it. "Well, thanks for your time, Doctor."

"There's more. I don't know where you got this from, but you were also on the mark about analyzing its crystalline structure."

"Really? Why?"

"It has an odd structure to it. I'm not good at describing things, but it looks like a grid. Or a piece of graph paper."

"You mean, like two sets of perpendicular lines?" I asked.

"Exactly."

That seemed to fit what Glen had said about the cavorite acting like a pair of polarizing filters at right angles. I had no idea whether that could actually block quantum states from getting through, but at least the analysis was consistent with his explanation.

"Dr. Lott, you've been a big help."

"Sure. Anytime."

I hung up the phone. "Well?" Jon asked.

"It's granite, but with some interesting properties. I'm still going to have to take it back to Washington for a full analysis."

"That's too bad," Jon said. "Can I see it again?"

"Sure," I said, passing it over. "Sorry I couldn't prove anything about Glen."

Jon grunted. "Maybe I'm just being paranoid."

"No, you're not," I said. "You're right that all the evidence indicates that Gerber wasn't the suicidal type. But unless we knew how he could have been murdered in a locked room, suicide is the only possibility."

"Yeah," he said, and he handed back the cavorite. "Granite, huh?"

"Granite," I echoed, and I started to slip it into my pocket. "But I'm sure we'll find out something more—"

I stopped with my hand in my pocket, still clutched around the rock.

"My pocket . . ." I said, staring out into space.

"Drew? Are you all right?"

I withdrew my empty hand and studied it. "The cavorite is in my pocket."

"Drew?"

I smiled at Jon, and took the rock back out of my pocket. "I won't need to take this back to Washington after all. If Glen Mitchell did murder Gerber, now I know how he could have done it."

Jon and I made some plans, and late in the night I went back to my motel to get some sleep. The next afternoon, feeling somewhat exhausted, I went back to the Media Lab and met Jon again at his office. We went over the plan one more time, and then we headed down to the physics and media Lab.

Sure enough, Glen was working in the lab when we got there, bent over some piece of equipment. I hadn't seen him since Jon and I had spoken with him together, and he looked a little disheveled. He glanced up at us when we walked in and continued fiddling with some wires. "Hello, Jon. Hello, Drew. Teresa and Andonios tell me you've been talking to them."

I nodded. "The government has decided that it's interested in this teleportation experiment. Would you be willing to answer a few more questions about the QCTs?"

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Glen sighed and took a few moments to bind two wires with electrical tape. He looked up at me with an exasperated expression, but quickly changed it to a smile. "Sure, as long as no one comes to take the experiment away."

I shook my head. "We'd just be interested in reproducing it on our own."

He bit his lower lip. "Let's go into the Safe Room."

Jon glanced at me, and I nodded slightly. Glen followed us in, then closed the door and bolted it behind us. "So what do you want to know?" he asked.

This was it. "I've been thinking about Gerber. Jon tells me that it's unlikely he'd have committed suicide."

Glen turned around, and slowly paced away from us. "What does this have to do with the experiment?"

"Everything. Didn't you find it strange that he committed suicide?"

He nodded. "Of course. But we found him locked in this room, gun in hand. Perhaps there were some pressures on him that he hadn't told anyone about."

"Perhaps," I said. "But something else occurred to me as a possibility, something I wanted to ask you about."

"What is it?"

"Is it possible," I asked slowly, "that Gerber was murdered?"

To his credit, Glen didn't immediately protest or act indignant. Instead, he looked thoughtful. "I can't see how," he finally said.

"Why not?"

"Because we found Gerber in this room, and it was locked from the inside."

"But what if someone entered the room with him, shot him, and then locked the door and teleported out? Then it wouldn't matter that the room was locked."

Glen shook his head and tensed up. "It's not possible. The walls of the room are lined with cavorite. There's no way anyone could teleport through them."

I walked over to one of the steel walls and banged it with my fist. "It does feel nice and sturdy, doesn't it? And from what I've read in Gerber's notes, you're right. No one could teleport through the cavorite."

Glen visibly relaxed, and then I said, "But someone could teleport the cavorite itself."

He tensed up again. "What do you mean?"

I pulled the piece of cavorite out of my pocket and tossed it up and down in my hand. "When you teleported me, this was in my pocket."

"So?"

I threw the cavorite to Jon, who pocketed it. "So, the cavorite wasn't left behind when you teleported me. It got me thinking." I walked around the room, and gestured as I explained. "What if someone teleported the cavorite out of the walls of the Safe Room, murdered Gerber, and then put the cavorite back into the walls after teleporting out? Tell me, Glen, doesn't that sound possible?"

Glen was beginning to sweat. "Why would anyone go to such lengths in the first place?"

It was Jon's turn now. "Professional jealousy," he said. "Maybe an ambitious graduate student wanted to take much more credit for the transporter than he deserved."

Glen turned to face Jon. "Are you accusing me?" he asked, an edge in his voice.

I opened my mouth to say something to calm him down, but Jon interrupted.

"You had motive and opportunity, Glen. And a previous record of illicit behavior, right here at the lab. You could have teleported the cavorite out of the walls without Gerber knowing, and then teleported it back in after murdering him. Who would have known? You and he were the only ones—"

A gun appeared in Glen's hand, the old-fashioned way. It must have been hidden in his lab coat. "Hands up!" he shouted, before I had a chance to reach for my own handgun. As Jon and I raised

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our hands, he looked straight at me. "I can't believe I was so stupid as to let you keep that piece of cavorite," he said.

"Glen, don't do this," Jon said. I could see the fear on his face. "Three deaths are a lot harder to explain than one."

"Maybe so, but you're assuming that I'd leave your bodies here, like I left Gerber. Gerber deserved to be left in his own lab. I'll just teleport your bodies into the ocean, where no one will ever find them. They'll never connect your disappearances to me."

"There's one flaw in your plan," I said.

He waved the gun at me. "A flaw? Yeah, right. Tell me another one. What flaw?"

"This one," I said, and as loud as I could I shouted, "Now!"

Two Cambridge police officers appeared instantaneously on either side of Glen, their guns pointed straight at him.

"Drop it," they said in unison. He did, and they cuffed him.

"Did you get all that?" I asked one of the officers.

"Yes," she said, as the other officer began reading Glen Mitchell his rights. "It's on tape. They should have no problem convicting him."

"The tape's not admissible."

"Even so. We'll be able to find other evidence, now that we know the truth."

The door to the Safe Room opened, and two more Cambridge cops came in to lead Glen away. There were also some MIT Campus Police milling about. Glen glared at me. "How did you—"

"Jon and I just performed the same trick you did. Last night, we came here after you were gone, and teleported out the cavorite lining inside the door. As soon as you locked the Safe Room door, the police came into the lab. It was a piece of cake. Or cavorite, as it were." What I didn't tell Glen was how hard it had been to convince the police to take us seriously. Fortunately, with a little help from the MIT police and the Media Lab Director, we had been able to set up our trap.

The last thing I heard Glen say was "Damn you," and then the police escorted him out of the lab. I told them I would be down to file a report within the hour, and then headed back to Jon's office with him.

"Looks like you were right," I said to him once we were seated. "Thanks for bringing me in on this."

"You're welcome. There's still one piece of the physics that I don't understand."

"What is it?"

"When we first went down to see the lab, I thought you said a receiver was needed for teleportation to occur."

I nodded. "It is, but there's nothing that says that the object teleported has to appear *inside* the receiver. It's more of a focusing mechanism. As long as you have a device present to disentangle the quantum states, you can focus the reappearance anywhere nearby you want."

He smiled. "Like, inside a wall. Or next to a murderer."

"Exactly." I sighed. "You know, this is so ironic."

"You mean because Gerber was murdered with the help of his own invention?"

"That too, I suppose," I said. "But what's even more ironic is that this is the last time a locked room murder will ever be a mystery. It's the ultimate locked room mystery, in the real sense of the word 'ultimate.'"

The next day, I got back to Washington and filed a report on the case. A few days later, Rotstein called me into her office.

"We passed the information on the Gerber case up the ladder," she said.

"And?"

She paused. "You were right. The engineering division is most definitely interested. They've asked the Media Lab for the QCTs and Gerber's notes."

I felt cold. "Asked, right? Not demanded?"

Rotstein laughed. "Don't worry,

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Drew. The Media Lab will be well compensated. And given that Gerber is dead and Mitchell has been charged with his murder, there's no one there to work on this experiment anymore."

"Um. So who is the engineering division going to get to work on the QCTs?"

She smiled. "Now, that's interesting. It seems that no one in the bureau is an expert on quantum cryptography."

"No one?"

"Well, except for you, of course."

I goggled. "Expert? Me? I'm no expert, I just read a few articles."

"You're the closest thing we have to an expert." She handed me a letter. "You're being sent to the Engineering Research Facility in Quantico to set up the QCTs and get the experiment started."

I read the letter and shook my head. "But I'm a field agent."

"It's not a permanent transfer, Drew. You're too valuable to me in Special Investigations. But they do want your help, until they understand enough of the science to work on the experiment on their own. You're to report there tomorrow."

I sighed and handed the letter back to Rotstein. "Ironic, isn't it? I joined the FBI to get away from research, and it looks like I'll be doing some of it after all."

"Don't worry," she said as I left her office. "I'm sure we'll have something else for you to investigate as soon as you get back."■

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volume of flat space that is connected to normal space by a tiny "neck." It therefore resembles the more familiar general relativity topologies of wormholes or "baby universes" and perhaps has a similar behavior. This raises the issue of how the neck is prevented from pinching off altogether, isolating our space travelers in a new universe of their own rather than transporting them to a new part of the old one.

I should also comment that these calculations were performed without a proper understanding of the unknown theory-to-be that we call "quantum gravity." A warp bubble with a diameter near the Planck scale will be affected by quantum gravity effects and corrections. In particular, my previous column (December 1999 *Analog*) described the possibility that extra space dimensions affecting gravity may be rolled up into loops about a millimeter in diameter. If this were the case, it would modify general relativity at the millimeter scale and would almost certainly render Van Den Broeck's metric unachievable.

Thus extra space dimensions might block the path to faster-than-light travel. Ours is certainly an interesting universe, and it grows more interesting as we understand it more fully.■

AV Columns On-line: Electronic reprints of 95 or so past "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available on-line at the URL: **http://www.npl.washington.edu/av**. The preprint referenced below can be obtained at: **http://xxx.lanl.gov**.

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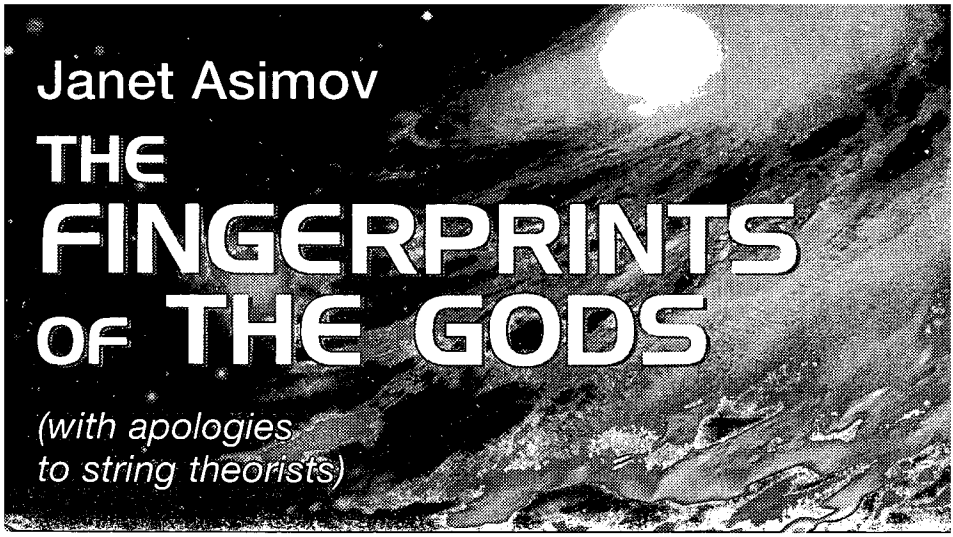

Janet Asimov

THE FINGERPRINTS OF THE GODS

(with apologies to string theorists)

Like all sensible beings, the gods were spending eternity trying to learn, but some of those taking Ultimate Reality 101 got fed up and wanted to make something. They argued about how to construct a universe, not that anyone really wanted one but it seemed like a reasonable means of self-expression.

As the quarreling got louder, the oldest god (who had flunked the course several times) shouted "Point of Order!"

And lo, there suddenly was a point. It was pure. It was simple. It was virginal. Neat and orderly, it hung there while the gods discussed what to do with the potential.

The oldest god listened for several eons, got tired, and kicked the point, which blew up.

The younger gods rushed to contain the explosion.

"You're not holding it properly," said the oldest god, who actually didn't care, but felt the youngsters should take every opportunity to improve themselves. "Your fingerprints are inserting imperfections. . . ."

"We're gods!" they yelled back. "We're perfect!"

They were wrong. Out of control, the expansion continued, imperfectly, the field engendering little vibrating loops of somethingness.

"Well, it's rather pretty," said the oldest god. "The loops make larger patterns. . . ."

"Patterns are not real," said a young god.

"Yes, they are," said the oldest god. "And look, some of them are becoming intelligent."

"Not important," said the younger gods. "They're of an odd size—halfway between small bits and large accumulations of somethingness. And they can perceive only time and three of the ten spatial dimensions."

"Oh, dear," said the oldest god. "On their level of perception, relationships between the very small and the very big will seem incompatible."

"Good," said the other gods. "This species will study one extreme and the other extreme and never realize that they are the same."

"But it would be so nice for them to explore and understand the beautiful smallest and largest patterns," said the oldest god.

The younger gods sneered. "Fortunately, they will never discover the loopiness of their Ultimate Reality. . . ."

"Wanna bet?" asked the oldest god, settling herself down to watch.

And it came to pass.

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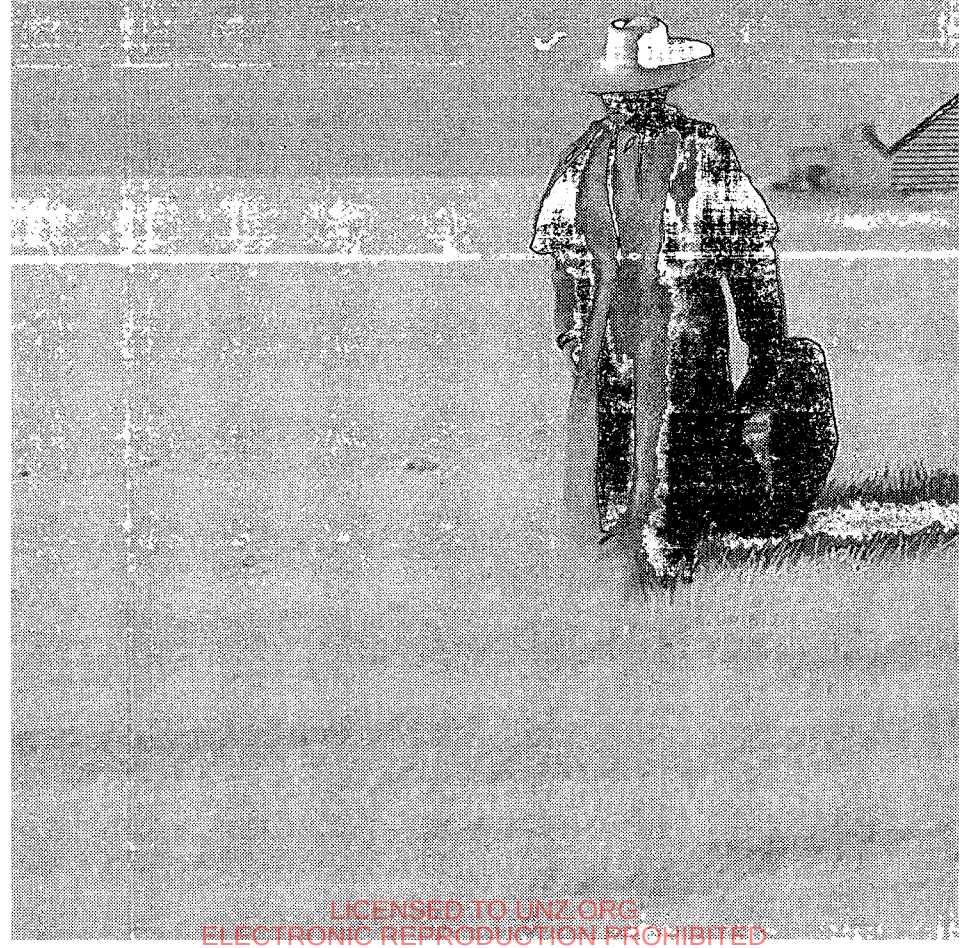
Charles L. Harness

RED SKIES

Sometimes people just get lucky—which is not always a good thing.

Illustration by Nicholas Jainschigg



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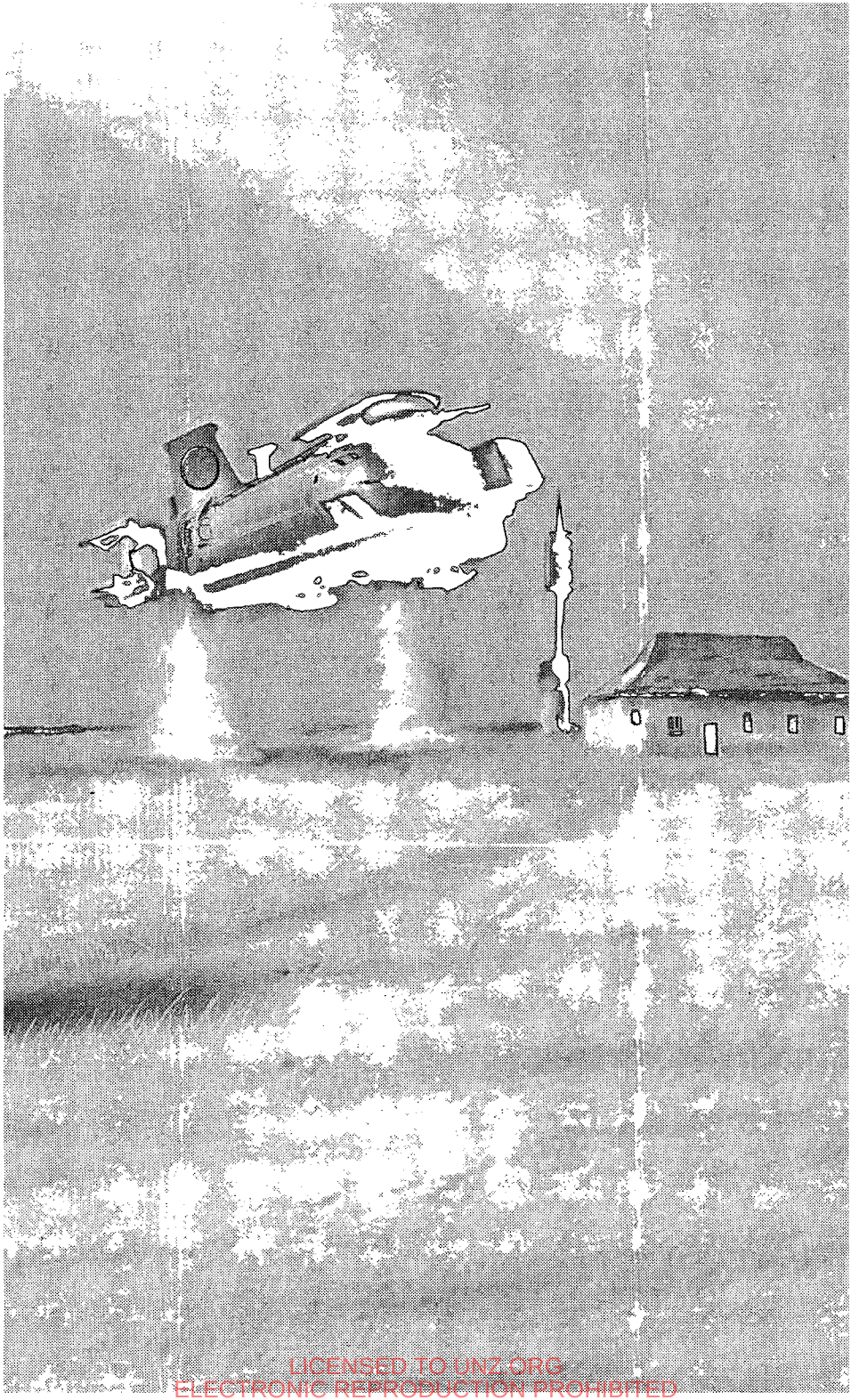

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He turned to watch the little freighter as it lifted off noisily from the tarmac a hundred meters away. He could feel the sound rather than hear it. For several seconds the craft looked like a black bug, running up and out toward the bright surface of the planet's ring.

As a spaceport it wasn't much. A few sheds, one undersize fuel tank with a pour-it-yourself hose. Evidently a privately financed construction job, and the only one (so far) on New Terra. Take it or leave it.

It was warm, and he was beginning to perspire. He took off his jacket and slung it over his shoulder. At that moment a minitruck roared up and braked to a screeching halt in front of the pile of boxes left by the ship.

A girl clad in overalls and a wide-brimmed hat got out of the vehicle and was walking toward the stack of freight when she saw him. She shielded her eyes and called out, "Like a ride into camp?"

"Yeah, sure." He hurried over. She dropped the tailgate and he helped her load the little pickup. "I'm Ben Rulain."

"Sally," she said, between boxes, then added with a smile, "Groceries for next month."

He was about to throw his valise in when she said, very seriously, "No weapons?" She had pleasant gray eyes.

He hesitated a millisecond. "No."

She noticed the travel stickers. "Looks like you've been around. Luna . . . Mars . . . Are you famous?"

He laughed. "If I were, you wouldn't have to ask."

"Figures." She lifted the case into the truck and slammed the gate shut. "Let's go."

She was in the driver's seat and had started the motor before he climbed in and closed his door.

The road was single-lane asphalt, and Rulain could see that it terminated half a mile away in a cluster of single-story frame buildings. His eyes narrowed slightly as they swept the horizon. There were no shrubs, trees, hills, just the dark green of the endless plain.

He took a couple of deep breaths. She noticed. "Invigorating, isn't it?"

"Yes." And he knew why. Volcanic activity on New Terra had ceased many millennia ago. No more nitrogen spewing into the atmosphere. But the carpet of minuscule greenery continued to produce oxygen, which had eventually reached near-inebriating levels. If what he suspected was true, the planet had had a long and glorious past; indeed, hasty incomplete archeological surveys had reported fossil evidence of fascinating life-forms, all now extinct, but active until perhaps ten million years ago. At which time everything had begun to die.

For New Terra was dead. And now certain people proposed to exhume the corpse—paint her dead body with highways and shopping centers and skyscrapers and megacities. Bring her back to life—restore the heartbeat. Highly questionable, he thought. She's the way she is for a reason.

He pulled a pair of goggles from a jacket pocket, flipped up the dark lenses, and studied the afternoon sun steadily for a moment. Alpha Aphrodite . . . "AA." A yellow G-2, much like our own Sun (he thought) . . . but yet perhaps dramatically different.

The girl watched this curiously. "Bigger than old Sol, back home, isn't it?"

"Yes, and hotter."

"So, what do you think of New Terra?" Perhaps she intended the question to be idle banter; but it held an edge.

He put the goggles away. "Truly fascinating. Earth-size planet with a sizable ring . . . three beautiful little moons . . . so they say."

Her eyes turned back to the road. "They didn't know you were coming, did they?"

"Why no, I guess not."

"Just luck I had to come in for that load. You would have had quite a walk.

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Next time, tell somebody. They don't like surprises."

They—he thought. Not *we*. Interesting. "Quite right. You're the only camp around?"

"Yeah, and actually the only one on the whole planet, so far as I know. Just us. Surveyors, for Green Acres. The corporation. I think they're closing down soon, and we'll all be moving out." She seemed thoughtful. "You'll have to see the manager about a room. That's Dave Katling. And arrange for meals."

"I can pay."

She shrugged. "Not a question of that. They just don't like strangers messing around. They'll probably want you out on the next freighter." She turned, faced him, frowned. "Not that it's any of my business, Mr. Rulain, but why are you here, anyway?"

He laughed. "No great mystery. I'm a member of a government engineering group, and I have a matter to discuss with one of our people here." He sensed immediate tension.

She seemed to focus intently on the road. They were a bare hundred yards from the camp loading dock, and she was slowing down. She said quietly, "Who?"

He had to make a crucial decision very quickly. "Carter Komas," he said. He watched her hands.

She jerked, the vehicle swerved, she regained control almost instantly. That bad? he thought. The truck pulled up to the dock and rattled and stopped. She said, "Mr. Rulain, can you take me with you when you leave?"

The question chilled him. He said evenly, "You could have left on the freighter."

"No. It's the fare money. I signed on for the summer. I don't get paid until the end." She didn't look at him.

"Komas?" he said.

"You better go on in." She spoke now with tight control. "Find Dave. I got to unload. Probably see you later, after supper maybe. I'm the cook. Steak and potatoes tonight." In a low monotone, almost a whisper, she added, "One point three kilometers due west."

Without looking, he knew she had left the key in the ignition.

He found Katling without difficulty. In fact the manager was waiting for him as he entered the little lobby of the main building. The man's mouth was twisted in a forced smile; black eyes narrowed as they studied the newcomer. There was one minor contretemps: the buzzer sounded as he passed through the doorway. "Metal detector," Katling explained politely.

"Flashlight and wristwatch, probably," Rulain suggested. He handed them over and tried the doorway again, this time successfully.

"Room seven, down the hall," Katling said. "Why don't you wash up, then rejoin me here in the office, and we can talk."

Right on, thought Rulain. As soon as I walk out of this office Katling will get on the computer. By the time I get back he'll know who I am and why I'm here. Which is fine with me. They'll search my valise, but they won't find anything. I wonder who else is here. Could be quite a party shaping up.

He was back in fifteen minutes. As Katling watched him enter his upper lip lifted into a sneer blended with reluctant respect. "Well, well, Dr. Benjamin Rulain, Terraformers. To what do we owe the honor of this visit?" He examined the scientist with sharp darting glances that reminded Rulain of a weasel sniffing for prey.

"Mr. Katling, I'm looking for Dr. Carter Komas, one of our scientists. He was supposed to check in with us several weeks ago. He didn't."

"Mmm . . . Komas. . . ? Just let me see." He swiveled around to the computer. "You know, a lot of people are in and out of the camp. Some come by special transport, don't even stay

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overnight. We don't record everybody. Mmm . . . no, no Carter Komas. Was he prospecting for metals? Gold? Uranium? Transuraniums? These old prospectors disappear into the hills, sometimes you don't see them again for weeks, months, even."

"There are no hills on this planet, Mr. Katling. And Dr. Komas was not a prospector. He was a heliologist. He was studying Alpha Aphrodite."

"One of those people, eh? What a coincidence! It just happens, we have a famous heliologist in camp this week. You may meet him later on. Well, too bad about your Mr. Komas. If he was ever here, it was before we started keeping records."

Bad, very bad. Yet all pretty much as expected. He said gravely, "Thank you for your time." He rose, walked unhurriedly out of the office, on through the lobby and out the front door.

He looked up at the sky. The outer arc of the great ring reflected AA's radiance like a mirror. And with New Terra's thirty-six hour day, he could count on several more hours of daylight. Plenty of time. He looked around. Katling, breathing hard, had come up behind him. He turned around. "I'd like to borrow the pickup," he told the manager.

"No, you can't . . ."

"For a couple of hours. I'll have it back by supper."

"You . . . no . . ."

But he was into the truck and gone. Katling ran after him for a few yards, yelling, then quit.

One-point-three kiloms. He watched the odometer carefully.

From previous reports he knew that the endless green sward represented the climax land-life of the planet: just myriad tiny grasslike florets. Nothing moved. No insects, no vertebrata. Chlorophyll in the greenery was maintaining the oxygen content of the atmosphere to little visible purpose, if one discounted the half-dozen or so occupants of the Green Acres camp. Aerobic microbial life in the distant seas probably prevented excessive O_2 buildup. Had there ever been humanoids here? Perhaps. If so, they were long gone. One by one, during past millennia, individual species had ceased to evolve. And then, one by one, had ceased to reproduce. Plate tectonics had subsided millennia ago. No more earthquakes. Ocean currents flowed slowly, serenely. With no real moon, tides were barely measurable. There were no strong winds, just Coriolis zephyrs.

New Terra had been discovered as a result of exploration through one of the new Jaquino Gates—wormholes in space that permitted direct passage into distant sectors of the Universe, or indeed (some claimed) into other Universes.

Until very recently only the Terraformer Administration had possessed both the budget and the technology necessary to construct and operate the mysterious Gates. Last year, however, private industry had sensed the profits to be made in discovering planets both readily accessible and colonizable, and had begun building their own Gates. The Green Acres Jaquino Gate was one of the new ones, and by happy circumstance opened into space quite near an Earth-like planet, which the corporation promptly claimed as a possession, much as Columbus had claimed the Western Hemisphere for Spain.

But there was a mystery here. New Terra seemed to know something that its visitors did not. And yet, here was Green Acres Inc., on the verge of completing a planetwide survey. The giant corporation was preparing to offer immense tracts of land for colonization. He had read the brochures.

One-point-two kiloms. He noted a vague discontinuity off to the right. He stopped the truck, got out and knelt down to examine the turf more closely. He gritted his teeth then shook his head grimly. The little green plants hadn't grown back properly. He was certain

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that he was looking at the grave of Dr. Carter Komas. They hadn't even put up a marker.

Beyond the grave lay several square meters of solar panels. The shaft must be nearby. He looked about and located a simple iron plate painted a mottled green. There was no lock. He lifted it on squeaky hinges and looked down. Wooden steps led into darkness. He knelt and listened carefully. Everything was silent. His nose twitched. He sniffed. A strange odor, faintly acrid. Damn them! What had they burnt? He'd soon know. He pulled out his flashlight and let the beam sweep back and forth a moment. There was supposed to be a light switch, toward the bottom of the stairs. Yes, there. And down we go.

The Terraformers, despite several administrative fumbles and budget cuts, had built this admittedly rather modest facility around a pre-existing underground pool. They had accomplished this within three weeks following the discovery of New Terra and under conditions of great secrecy. But perhaps not secret enough, thought Rulain. The administration had never certified the planet as suitable for colonization, but Green Acres had pulled strong political strings and practically overnight had moved in anyway.

This subsurface laboratory existed for one purpose only: to analyze the neutrino flux from this fine yellow sun, Alpha Aphrodite. The tiny neutrino (he mused) was an insignificant particle. It had no charge, little or no rest mass, no radius, and moved at or near the speed of light. It obeyed only the so-called weak force, which meant it was very shy and hard to make collide with anything. With a lone neutrino, passage through a light-year of lead would be required to guarantee a strike. So, to detect the elusive little beastie, we resort to a lot of neutrinos, and a thinner target, such as the one in this underground laboratory.

Why this interest in such a near non-entity? Because it reveals the life and death of suns.

And so the administration had put one of their best heliologists here to monitor the works—Dr. Carter Komas. Rulain had helped the young scientist design the apparatus and the layout, and he felt a heavy measure of responsibility for the fate of his protege.

Slowly, carefully, with the aid of his flashlight he began to descend the steps.

So—what had his young friend told the rogues of Green Acres that had got him killed? The answer had to be down here somewhere. He clenched his fists and inhaled sharply. Did he *want* to find that answer? Well, yes and no. Yes, he had to know. No, he didn't want to die. But how he felt was probably irrelevant. Now that he had begun his search, *they* couldn't afford to let him live.

He reached the bottom step, stopped, leaned back against the steps, shuddering. He knew it was just a delayed reaction, rage for the murder of a colleague, fear for his own life, bitterness for the destruction he knew he would find. And finally and very importantly he knew he would have to pull himself together if he were to come out of this alive. After a time his pulse and respiration settled into acceptable rhythms.

He found the light switch with his flashlight. To his great relief, overhead fluors suddenly illuminated the chamber with a vague semi-light. They hadn't bothered to rip out the lighting system. He looked around slowly. The astringent odor he had noted earlier was coming from a charred pile of notebook pages a couple of meters away. He walked over, sifted through the destruction with his bare hands. Everything was hopelessly carbonized. No, wait, there was something at the very bottom, perhaps the heat hadn't got to it. A computer crystal. He studied it carefully. Maybe . . . What I need now . . . He looked around.

The sparse overhead lights reflected off a pond lined with several dozen photomultiplier tubes, each half a meter in

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diameter. A narrow walkway led him around the pond margin and deeper into the chamber. Here he found the computer, with the monitor turned on its face. Next were the recording apparatus, work tables, and radio console.

He readjusted the computer, inserted the crystal, watched the screen come to life . . . in incomprehensible fragments.

". . . 150 . . . incompl . . . Rb-87/Sr-87 . . . 8/Pb-206 - 10±0.1 . . . A-40 . . . . . enoug . . ." Meaningless? It had not been meaningless to Carter Komas. It had been his death sentence.

So, thought the scientist, let's back up. Lead 206. When uranium 238 decays, the final product is lead 206. Carter was radioactive-dating something. A local mineral? And he got a date—ten billion years. Huh? I don't believe it! Another try—rubidium 87 decays into strontium 87. We don't know what date he got. Ten billion? Still another—what gives argon 40? Potassium 40. What did he get? We don't know, but I have a good idea. And Carter made other checks. "150"—put that in kilometers. He measured the distance of New Terra to its Sun. It came out to 150 million kilometers.

Despite the subterranean chill, little beads of sweat began forming on Rulain's forehead. But the ring, he thought. And the little moons. How do they figure? A good way to find out.

He moved his chair over to the radio. Several days before his arrival, fearing the worst, he had arranged for a security cutter as backup, and theoretically the little ship was presently cruising out of sight in orbit around the planet. "Rulain to cutter. Come in."

The response was immediate. "Karos here. Go ahead, Doc."

"Roy, I have a quick and dirty for the mainframe."

"Say on."

"I need an aggregate mass for New Terra's ring plus the three little moons. I'll wait."

"Got it. Working, working . . . How is it down there, Doc? Any trace of Komas?"

"Dead, Roy. And I think you'd better move into closer orbit. Just in case. More later—"

"Hold it, something coming in. Yeah. Total mass, $7x10^{22}$ kilos. They say they could refine that a little if you can wait about an hour."

"No, that's close enough. Out."

Rulain pushed his chair back and sat there for a moment, just thinking.

The original object of this underground project had been quite simple: monitor neutrino flux in Alpha Aphrodite. And that was all. But apparently Komas had grown curious and had branched out and had come up with a very interesting discovery.

It all added up. 150: 150 million kilometers was the distance of New Terra—and of Earth—from its Sun. The mass of ring and moonlets circling New Terra was almost exactly the mass of Earth's Luna.

New Terra was Earth, aged another five billion years, for a total of ten billion years. Komas had told the Green Acres people, and they had not welcomed the news. They had killed the messenger.

Rulain frowned. How could such a tremendous time glitch have happened? Obviously something had gone seriously awry in programming the Jaquino Gate, the *vermebuco* or "wormhole" that permitted direct passage to other Universes.

The great astrophysicist Marc Jaquino had designed his *Processo* to bring questing ships into the past, on the theory that movement back in time would be more likely to find primitive young planets as yet unoccupied by hostile intelligent life and readily colonizable by overflowing Terran populations.

But it was clear to Rulain that the Green Acres Gate had somehow jumped five billion years into the *future*. Worse, the Gate had never left home. It had exited onto a moribund Earth, called *New* Terra! The scientist considered the irony and shook his head in wonder.

What now? Well, while he tried to fig-

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ure out what to do next, he might at least check up on the main reason the young heliologist had been stationed here. Neutrinos.

He stood in front of the recorder case and watched the paper scrolling down slowly, millimeter by millimeter. Very good. Still doing its job. He continued to watch. His eyes narrowed, and he frowned, and then he took a deep breath. "Ho-ly Hub-ble. . . !" It came out in four syllables. After a moment he pressed buttons on the side of the case. The tape stopped, rewound fifteen or twenty centimeters, started forward once more. He studied it again, groaned faintly, then opened the case, extracted the spool, and hurried to the radio console.

"Rulain calling cutter. Come in, please."

"Karos here. Go ahead, Doc."

"Roy, how long will it take you to come in?"

"Thirty minutes."

"All right. Please come in immediately. Silent running. Touch down close to camp. These people murdered Dr. Komas and we have to bring them in. And there's another problem. Signing off."

"No, Doc . . . Ben! Don't go back! Problem? What problem?" But there was only a click.

The heliologist shut the radio down and started back toward the cave entrance. When he reached the steps he looked up. No square of light. They had reclosed the iron gate. He wasn't surprised. His pulse began to accelerate. Idiots, he thought. He paused long enough to make certain adjustments in his flashlight, then proceeded on up the steps.

The iron plate was locked. They had probably just stuck a rod through the hasps. He placed his goggles over his eyes and pointed his flashlight in the general area of the loops. Even through closed eyes the light was dazzling. Sparks of hot metal stung his cheeks. Within seconds he was out.

He looked around. The little truck was gone. As expected. No matter. It wasn't all that far back to camp. He struck out with a steady stride toward the buildings, easily visible across the plain.

The Sun was sinking. The ring was high in the sky, its outer rim a glowing gold. He studied the western horizon for a moment. As might be expected, the sunsets were indeed Earthlike. Red skies. Very beautiful. How did it go? *Red skies at night, sailor's delight.* No, before that . . . *Red skies in the morning, sailors take warning.* Would there be red skies in the morning?

He picked up the pace a little and squinted toward the camp. Some kind of activity. Yes, here came the pickup, fast, scattering turf in powdery sprays. Its lights blinked a couple of times. Sally? He fingered his flashlight uneasily as the little vehicle pulled up alongside.

She stared at him. "They told me . . . I was coming to get you out. You okay? You can't go back."

"Wrong. We have to go back."

"They'll kill you. I've got spare petrol, food. We can run . . . hide . . . for days. There are other caves . . ."

"Thanks, Sally, but no thanks. We're going back, and we're going to stay alive."

She studied him for a moment. "I hope you know what you're doing."

So do I, he thought. He got in.

They were gathered and waiting as he and Sally entered the dining room. Two men with rifles hovered unobtrusively along the side wall.

Katling looked grim. "First, the flashlight. So-called."

Rulain fished it out and tossed it on the table. He took the chair Katling indicated. Sally sat next to him.

The manager continued. "You know Dr. Melchior, our First Vice President?"

"Of course." Rulain smiled. The Terraformers had fired Samuel Melchior years ago. "How are you, Sam?"

"Tolerable, Ben."

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The man at the head of the table was tall and heavy, neither ugly nor handsome. Something in between. Not fat, just well-padded. Dark hair, gray patches at the temples. A monocle, which he seemed to wear as a badge rather than an optical aid. He wore a gray silk vest with a gold chain that terminated in watches at either end, one keeping local planet time, the other Greenwich time. The new thing. A man of culture, charm, accustomed to elegant things, who might go to almost any extreme to maintain the affluent life. A man, thought Rulain, who would sell his soul to the Devil. He wondered how high the Devil would have to go.

The corporate officer said, "Ben, before we get started, I'd like to explain about Green Acres Inc. I think I can clear up several things that may have puzzled you and the other Terraformers."

"Sure, Sam. Go ahead."

"Point Number One. We speak here not of mere nations . . . countries . . . continents. No. Green Acres involves a whole planet. Back on Earth an interplanetary syndicate of bankers is about to exercise an option to acquire the entire habitable surface of New Terra. The amount of money to be transferred to Green Acres exceeds the gross continental product of North America anticipated for the next decade. That's a lot of money, Ben, and it will be ours in seven days."

Rulain smiled. "Unless the optionors get nervous."

The executive looked at him, frowned, then laughed. It was without humor, a short, brittle bark. "Quite right, Ben. And you can understand that we might go to considerable lengths to keep them calm." He sighed. "You see, a venture of this magnitude carries its own special rules of morality. What you call fraud, Green Acres calls mere variance. What you call crime, we call mere expedition. What you call homicide, the corporation calls simple necessity. Removal of offending personnel is not merely excusable: *failure* to remove becomes inexcusable."

"Interesting," murmured Rulain. "I had never really thought of it in exactly that way."

"As in war, Ben, we see no right, no wrong, except as it contributes to ensuring victory, which in our case is that the syndicate joins me at the contract table in London next week."

"And so Carter Komas had to die."

"Actually, no, he didn't. All he had to do was endorse our prospectus. He would have lived, and he would have been rich."

"I've read your prospectus, Sam. Real work of art. It predicts a long and useful life for a brand-new, virginal planet."

"Exactly. We believe that."

"But Dr. Komas didn't?"

"Well, Ben, he had some strange ideas. I think the loneliness finally got to him. He made those silly little tests. He wanted to make an interim report back to your administration. We didn't have time for that."

"The bankers syndicate didn't know he was here?"

"No, of course not. If they had known, they would have stalled . . . waited for his report . . . and who knows what he might have said?" He shrugged. "Ben, now that you understand the situation, I hope you are going to be more reasonable than your misguided colleague . . . God rest his soul. But let it go. For old times' sake we offer you the same deal we offered Komas." He pushed a document across the table. "Sign at the x. Here's my pen."

Rulain studied the document briefly. "Ah, yes. New Terra is a virginal planet and is safe for colonization. Personally inspected and approved by Terraformers' Chief Heliologist. Sign at the x and live." He looked over at Melchior. "You offered the same deal to Dr. Komas, and he refused, and you killed him?"

"Heart attack, I think our autopsy says. A pity, a great pity. Such a brilliant young man. Cut down in mid-career."

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Rulain's mind was racing. The situation must not climax too soon. He needed time. How much of his thirty minutes was left? Stall, delay. He spoke slowly. "Let us negotiate, Sam. Let me explain what I found in Dr. Komas's underground lab. When I'm through, tell me if you still want me to sign. Deal?"

Save for much heavy breathing there was a prolonged silence around the table. Finally Katling said deferentially, "Dr. Melchior?" There was an uneasy edge in the question.

The executive took a deep breath. "If I seem to hesitate, it's because it doesn't sound quite right . . . a career Terraformer suddenly developing a sense of reality . . . oh, all right, Ben. Ten minutes."

"Fair enough." His voice became soft, relaxed. "Sam, let us start by not insulting our mutual intelligences. You killed Carter Komas because he told you that New Terra is in fact Earth, aged another five billion years, and Alpha Aphrodite is in fact our own Sun, Sol. Everything matches: planet size, 23-degree axial tilt, distance from the Sun, orbital period. The Moon slowed the rotation of the Earth, finally giving the thirty-six hour day. And then the Moon was pulled inside Earth's Roche Limit, where it broke up, giving the ring and the moonlets."

"An interesting, if totally erroneous, rush to judgment," murmured Melchior. "Out of the numberless-quadrillions of planets in the several Universes, surely Earth isn't the only world with the properties you list? And how do you arrive at five billion years into the future?"

"Easy. Radioactive dating, confirmed by what the constellations as viewed from Earth would look like in another five billion years. Exactly as you see outside, now. Your Jaquino programmer fouled up badly, Sam. Your Gate opens the wrong way."

Melchior shrugged, then smiled. "Ben, you are still overlooking one very fundamental fact. Aphrodite—old or young—cannot be Sol. Aphrodite is at least ten percent bigger and more luminous than Sol. *Ergo,* New Terra cannot be Earth."

"Sol would become larger and more luminous in its last years, Sam. It's the fate of every G-2 star."

"Which merely begs the question, doesn't it? AA is Sol in its last years, therefore it's more luminous? What kind of silly logic is that?" He shook his head. "No, Ben. Let us say, *arguendo*, that New Terra is perhaps not a fresh brand-new planet, with a full warranty, as it were, but possibly indeed rather old, with terminal mileage. We might further concede that knowledge of the fact might raise doubts about the corporation, and might cause delay in signing the contract and transfer of the money."

He adjusted his monocle and looked benignly about the room.

"On the other hand, the only person who seems to have such doubts is . . . an honored guest . . . who I am sure would rather endorse our prospectus than . . . ah . . . cause embarrassment." His voice became even more oily. "Ben, we are down to the wire. How will it be?"

"Let me finish, Sam." He did not wait for permission to continue. "The question: can New Terra be safely colonized? Actually, Sam, gentlemen—" he looked grimly about the table "—the answer to that depends on an even bigger question. Sol—AA—however you call it, is ten billion years old. Its increased luminosity proves it is terminal. It must soon—as solar times go—turn into a red giant. How soon is soon? I think I can answer that." He studied the men around the table. Several were leaning forward, listening intently.

Melchior snorted. "Not so fast. Granted, like all G-2 stars, AA will of course eventually explode into a red giant. And maybe she is indeed, as you say, 'terminal.' But *how* terminal? I say the planet, even if terminal, may well have several million years left—a trifle in geologic time, but an eternity in human affairs."

"Point well taken, Sam. Yes, here it

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gets tricky. How terminal? How can we find out? Neutrinos, that's how. We know the theory. The heat at the Sun's core converts hydrogen to helium plus gamma rays and other things, including neutrinos. Same as in any G-2 star. It's those little neutrinos that interest us.

"Now, when the star's core begins to run low on hydrogen fuel, it contracts—dramatically. This is the critical moment. Take note—*the critical moment.* During this contraction the star isn't converting hydrogen to helium and hence isn't making any neutrinos. But this silence is deceptive. Actually it's the lull before the storm, a pause for the star to gather strength . . . just before it blows."

He paused. Katling was staring at him wide-eyed. Melchior was frowning and slowly polishing his monocle with a paper napkin.

He went on. "In short, and skipping a lot of crucial steps in solar alchemy, the star now begins its expansion. Within hours it becomes a red giant, junior size. It engulfs Mercury. Then it stops for a while to gather strength, but eventually starts up again."

He took a deep breath. His ten-minute reprieve was long gone, but now it didn't matter. He had their attention and would probably be able to keep it for another several minutes. Interesting. His continuing existence depended on his ability to string out an inherently dull scientific lecture. Minutes of life bought with words. Onward! "In time it achieves its true majesty and swallows up both Venus and Earth. Mars escapes actual destruction but is far too hot to be habitable. Jupiter? Saturn? Uranus? Neptune? Who knows? Irrelevant. Nobody would be left to care.

"But let's back up. That critical instant—remember?—the moment of truth. At this critical moment, when the core is finally full of helium ashes, and old Sol—AA—must switch over to fusing hydrogen to helium on the core surface—shifting gears, as it were—there is a period of time, a matter of hours, when AA isn't fusing hydrogen to helium and hence isn't making any neutrinos. During this time a neutrino detector would continue to pick up neutrinos, but the incoming flux would be relatively low, just a trickle, resulting simply from collisions of cosmic rays with atoms in New Terra's atmosphere. Let us suppose that that trickle time passes. Then let us suppose the detector suddenly starts picking up lots of neutrinos again. That would mean the hydrogen-to-helium fusion in AA is back on and that AA is about to blow."

He laughed shortly. "You get the picture? One day the star is all fair, genteel, loving, nurturing, as she has been for the past ten billion years. The next day she's on the way to becoming a red giant, rushing out to destroy us. We take the hint. We try to leave, but maybe it's too late. Our little ships are fast, but the hungry red giant is faster. It could be quite a race."

From the corner of his eye he noted that Katling was licking his lips and frowning. Melchior's expression was undecipherable.

He continued. "Ah, that critical moment! Is there any way to see it coming? Yes, there is. We watch for that drop in AA's neutrino production. And how do we do that? It isn't easy. Neutrinos don't react readily. To detect them we have to trick them—seduce them with an atom or molecule they can interact with. Fortunately, the water molecule works fine. Dr. Komas used an underground pool, insulated all around by bedrock. This he lined with photomultiplier tubes and hooked them to a recorder. Trillions of neutrinos flow through the surrounding rock and enter the water every second. Most leave no record. However, every once in a while one gets within one quadrillionth of a centimeter of an atomic core in a water molecule and the so-called weak force takes over. Neutrino collides with atom. The reaction produces Cherenkov radiation—a distinctive array of photons in the water that is

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picked up by the photomultiplier tubes and reported to the recorder."

Melchior pulled a gold watch from a vest pocket, looked at it briefly, replaced it. "Ben, I think I see where this is going. With all respect for your very learned dissertation, may I offer a comment at this point?"

"Go ahead."

The corporation executive gave the heliologist a pitying look. "If your colleague had really thought neutrino detection was so important, he would have built a more sophisticated system." He shook his head. "Face it, Ben, as a research tool, your detector was useless at best, misleading at worst."

Rulain smiled. "True, there are bigger and better detectors. Ours was a small, rather simple Kamiokande model, with water target and photomultiplier tubes, tossed together in a great hurry, with materials we had on hand. Time was critical. We had one eye on your closing date and the other on Alpha Aphrodite. Despite its simplicities the detector worked. Dr. Komas found what he was looking for. He also found what he was *not* looking for."

"More neutrinos?"

"Neutrinos, yes. We assumed we would find plenty, and we did. We also found a temporary *absence* of neutrinos."

"Impossible."

Rulain looked at his watch. "One hundred and three terran hours ago, counting back from this moment, the solar neutrino flux stopped for several hours. It's on the tape. No question. And I think I have explained what that means."

"Oh, come now, Ben. No neutrinos? Most unlikely. Anyhow, no way to prove it, not with your crummy apparatus."

"You're quite wrong. For several days Dr. Komas measured total neutrino flux, from both Sun and atmosphere. This gave the norm. But then, on a certain very recent day there was a big drop in the total count. Why? Because we were getting only atmospheric neutrinos. No solars. But wait. Six hours later, just as suddenly, the count picked up again. We are getting solars once more."

"So what? You are tying all this to a hiccup in very dubious equipment." He looked up sharply. "Hey, what was that?"

Rulain and Sally exchanged quick glances. He mumbled something to her. The young woman said quickly, "The laundry machine . . . slightly overloaded."

"Sounds like it needs oiling," Rulain added blandly.

There was a long deep sigh. It was Katling. "Doctor, bottom line. Are you trying to tell us that Aphrodite—Sol—whatever—has passed your critical moment? That she is going to explode into a red giant? Soon, I mean?"

Out of the mouths of babes, thought Rulain. "Yes."

"When?" said Katling.

"About two hours from now." He pulled the little spool from a pocket and placed it on the table. "It's all there on the tape."

No one made a move toward it. Katling, wide-eyed, pushed his chair back a little.

"It's not that kind of bomb, fellows," Rulain said mildly. "Just a simple prophecy."

There was a long silence, finally broken by Melchior's genial laugh. "A most admirable presentation, Ben, and certainly an exciting conclusion, rabbit out of the hat, as it were. But in summation, it's all utter nonsense, isn't it? You had your say, as promised. For a while I thought you might be sensible. But no. So now it's time we finished. And I assure you, I truly regret this." He pulled a hand laser from a jacket holster. "Outside? Or would you prefer here"—he snickered weirdly—"among . . . as it were . . . friends?"

Rulain said gravely, "Sam, for the record, did you kill Carter Komas?"

"Not that it makes any difference, yes,

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I did. And I'd do it again." He shook his head. "Ben, your mind is just too small to grasp the situation. Remember, we're not talking nations, countries, even continents. We're talking a whole planet. Komas interfered. He had to go. So must you."

"Is the condemned man permitted a last word?"

Melchior squinted through his monocle. "Make it short."

Rulain looked at the faces around the table. He saw anger, hate, and an overriding fear. He spoke softly. "Outside is a police cutter. It landed under silent running a few minutes ago. That was the noise you heard, not your laundry machine. Before we proceed, I suggest that Mr. Katling verify with a peek out the front door."

The office manager gurgled something and looked over at Melchior, who frowned, finally nodded. Katling was in and out within half a minute. "It . . . it's there," he gulped.

Melchior sighed and slowly replaced his weapon in its holster. With infinite care he readjusted his monocle. "In which case perhaps we should ask Dr. Rulain to continue with what were to have been his last words. Ben?"

"Thank you, Sam. Gentlemen, I am authorized to give you, each of you, a choice. Option number one: the paddy boat can take you back to Terra, where you will all stand trial for the murder of Dr. Komas. Or, number two, any or all of you can stay here and wait for your freighter, due back here in three days. I think it will never come." He watched them. Some seemed to get it, some didn't. So be it.

He added, "If we are to outrun AA's explosion the police ship must leave within ten minutes. Sally, you come with me." He pushed his chair back and stood up.

She said, "Can I—?"

"Okay, one little carry-on bag. Be back here in five minutes. The ship—" But she was gone.

Starting with Melchior, he looked grimly around the table. The twisted bloodless face of the executive looked back at him unsteadily. "Ben . . . it's not really true, is it? Just an ingenious fairy tale to save your skin?"

Rulain smiled faintly. "You're the expert, Sam. You tell me. But even if you're wrong, think of the experience! Watching, *sensing* the big blow first hand. Being *there*, Sam, or should I say *here*, at that critical moment, when a yellow G-2 star starts to become a red giant. In a way, we bumbling incompetent Terraformers envy you!"

"But how was I to know you were telling the truth? Ben, for God's sake!"

Rulain noted with interest that Sally had materialized at his side with both her case and his. What was her last name? He'd have to have a long talk with her. The chief witness for the prosecution. "Let's go," he said. They had to wait a moment for Katling and several others to make it through the door ahead of them. Rats leaving the sinking ship, he thought.

"Ben! Ben! Wait up! For old times' sake!" The last rat.

A scratchy voice came over the intercom. "Cell block, Captain, there's a Mr. Melchior here, requests permission to view the explosion."

Captain Karos shifted his eyes briefly from the screen and the growing red sphere and exchanged glances with Rulain. "Permission granted. Bring him up. Cuffs and guard."

A moment later a guard brought the corporation chief into the crowded bridgeroom. "Stay with him," the captain ordered.

The silence on the bridge was interrupted by occasional gasps as the onlookers each in his own way tried to grasp the majesty of the spectacle.

In the growing red radiance Rulain stole a look at the portly prisoner. As Melchior stared at the crimson incandescence on the monitor his mouth slowly

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fell slack. Despite the overwhelming redness of the room, the man's cheeks were a dead white, and they melted, and sagged, and seemed to flow into a clump under his chin. He tottered, and but for the support of his keeper, Rulain thought he might have fallen. "I'm sick," the ex-executive groaned.

"Take him back," Rulain said.

Captain Karos blinked at the heliologist through the sea of red. "We're still looking at Phase One?"

"Yes. It has presently expanded through the orbit of Mercury. As seen from Earth—New Terra—it occupies one-twelfth of the horizon. Lots of steam. Our oceans are boiling away. And there it will sit for a few thousand years. Then, using a different mechanism triggered by helium fusion, it starts up again. It becomes a red supergiant. It gobbles up what's left of Terra, moves on to Mars." He laughed curtly. "But enough of this. It's time to leave. We've got to head for the Jaquino. Fast."

"Awesome," muttered Karos.

Sally said, "Shouldn't we have some sort of ceremony? Funeral orations? For AA? For Terra?"

Karos said, "I don't know . . . What could possibly be adequate?" He shrugged. "Too bad about Dr. Komas, though. We just didn't have time to exhume him for a proper burial."

"No, it's okay," Rulain said quietly. "According to his personnel file he asked to be cremated and his ashes scattered through the Solar System. He will get what he wanted."□

*(EDITOR'S NOTE: The Jaquino Gates and Ben Rulain first appeared in "The Terraformers" [*Analog *December 1999])*

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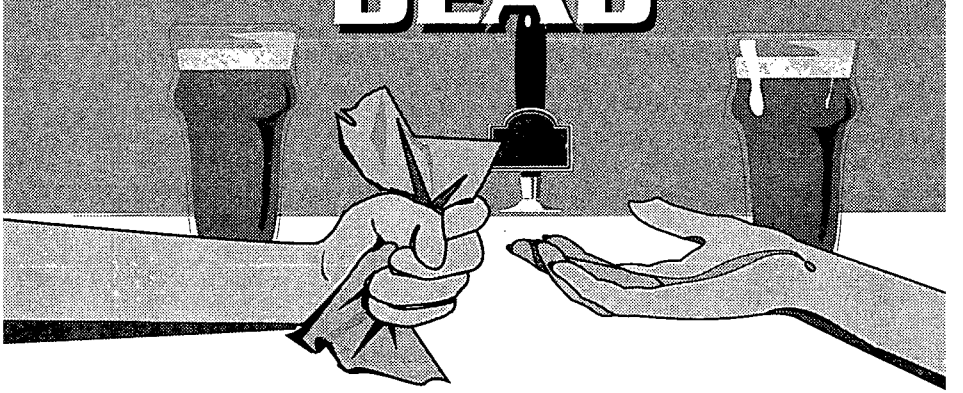
Brian Plante

I WISH YOU DEAD



Maybe even Sisyphus's problem was an opportunity in disguise. . . .

My boss, Fletcher, pulled the Rick-we-gotta-get-this-done-before-we-go-home routine on me at four o'clock in the afternoon again, so I wished him dead. He dropped like a rock, and his face turned a striking shade of blue as he sprawled across the cluttered desk. Everything in my field of vision flushed a vivid red, as if someone had turned up a bank of ruby spotlights. Another day shot. Rehab was like that.

It was January thirteenth in Manhattan. Again. It was my eighteenth January thirteenth in a row. On most of those other January thirteenths I hadn't even made it past lunchtime before wishing someone dead and turning the world red. I'd wished the newspaper delivery guy dead by making him drive his car into a tree for tossing my morning paper into a puddle. I'd wished an old lady at the train station to walk off the platform in front of an approaching train for stepping on my foot. I'd wished a heart attack on the snotty receptionist at the office for that "Banker's hours, Rick?" remark when I walked in late.

What made it especially frustrating about screwing up the day was that I already knew the incident with Fletcher was coming up. I'd made it several other times to that part of January thirteenth where he asks me to stay late, so I really shouldn't have blown up at him like that. I was so close to finishing out the workday, and after that it was downhill all the way, with just the commute back home to Staten Island where I could relax for the rest of the night. But it was all those little things that added up during the day that I let get to me, so I killed him again and tinted the day with my bloody brush.

Lucy Moore, Fletcher's secretary, popped her head into the office, saw our boss collapsed on the desk and started to scream. The world was already red with my failure, so what the hell, I wished her dead too. Her scream stopped abruptly as the breath left her

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lungs, and she slumped to the floor alongside Fletcher's desk.

A bunch of my co-workers had come out of their cubicles when Lucy started her wailing, and peered in the open doorway at the two dead bodies. The employees started pointing, shrieking and running, so I got up and walked out. With the day already hopelessly wasted, there was no need to stick around at the office.

I took the stairs down to street level and walked around the corner of 53rd Street to Hannah's. It was just a so-so restaurant that served mostly greasy deep-fried foods, like a thousand others in New York City, but the bar was okay. I ordered a couple of Killian's Reds and drank them quickly. The lighting at Hannah's was dim, and with a couple of beers in me, I could almost forget for a while that the world was red and that I'd have to spend another day in rehab repeating January thirteenth.

After the beers started to take effect and I'd calmed down, I began looking up and down the bar to see if there was even the remotest of chances I could hook up with a willing partner to take home for the night and forget about my problems. There was the good-looking blond in the green dress talking to her slightly homely girlfriend. She was about twenty-five or so and obviously on the make, and I thought I might try a line on her. Again. I had tried to pick her up once before on an earlier January thirteenth, but she had shot me down like I was some kind of disgusting worm. I wished her dead that other night.

As I approached and slid into the empty bar stool next to her, she turned away to speak to her girlfriend, obviously trying to avoid eye contact with me.

"Hey, can I buy you a drink?" I asked, making her turn around. "Vodka martini, right?"

The woman looked me in the eye, her face showing annoyance that a lowly slime like me would disturb her. I thought getting her cocktail of choice right this time, this January thirteenth, might make a little difference.

"Got one already, thanks," she said, turning back to her friend. The way she said it sounded like, "Go away and don't bother me."

"Lady," I said, "when I happened to know you drank vodka martinis you could have at least asked 'Do I know you from somewhere?'"

She turned to face me with drop-dead contempt in her eyes. "Hey look, buddy, I already have a boyfriend, okay?"

"Because," I said, "if you keep giving me this snotty bitch attitude I can just wish you dead on the spot again. I can make your brain explode or your skin peel off and it would happen, just like that. Is that what you want?"

Of course she didn't know what I was talking about. They never do. But I remember all the other January thirteenths and how they had played out.

"Why don't you find some other house to haunt?" she said. To her friend she whispered, "Creep," loud enough for everyone around us to hear.

I wished her poisoned and the next sip of her drink caught in her throat. The martini glass went flying as she crashed to the floor. After that the bar became a madhouse, so I called it a night and left.

I didn't wish anyone else dead on the way home. Sometimes I could hold it in.

The next day was January thirteenth again, of course, and it started clear and bright, the red curtain from the night before gone without a trace, just as it is at the start of every January thirteenth. A fresh start on the day; another opportunity to make it right. The newspaper got wet again, but I didn't kill the delivery guy this time. At the train station, the old lady stepped on my foot again, but I let her live. The receptionist made the crack about banker's hours again but I spared her life.

Three times during the day I tried to tell Fletcher that I couldn't work late

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tonight and had to get out at five o'clock. I didn't really have anything else important to do that evening, but I thought I could just head him off on general principle. It didn't work.

At four o'clock, he called me into his office again and said we (meaning me) gotta get these advertising reports balanced before going home tonight. I knew it was coming, but I still hoped my hints would have gotten through to the little weasel. I shouldn't have been so surprised but I was, and I blew up again.

This time I wished his head to fall off, and there were two separate thumps as he dropped to the floor. The curtain of red descended over everything. On my way out of the room I felled Lucy Moore before she could start yelling, and made it out the door before the office erupted into pandemonium again.

I went straight to Hannah's. Three Killians later I was calmer, but the world was still red.

I didn't even look at Little Miss Vodka Martini this time. No point in getting shot down once more, even if I could make her pay for it. Instead, I started jabbering to the bartender.

"You know, I've lived this day nineteen times already," I said.

The barkeep was busy mopping up spills and tips from the bar. "That so?" he said without really looking me in the eye.

"Yep. Been in this place six or seven of them. Today's already ruined, so I'll probably be back tomorrow. Well, not really tomorrow, but today all over again. But you won't remember me."

"Maybe I will, maybe I won't. Depends on what kind of a tip you leave."

That made me laugh. I hadn't laughed much lately.

"No, you won't remember me," I said. "I'm in rehab. This whole world is my rehab and you're a part of it."

"Really? Then would you care for some more medicine?"

I ordered another Killian's.

"I'm serious," I said between sips. "Almost everything is modeled on actual people and places, so there's probably a bartender just like you in a bar just like this out there in the real world, but in here you're just a sim. Tomorrow it will be January thirteenth all over again and I'll keep living through this day until I get it right. This one's been especially tough, though. I keep killing people."

The bartender looked puzzled and stopped polishing the glass he was working on, setting it down on the bar and reaching for my beer bottle. "Um, maybe you've had enough for tonight."

"No, it's all right," I said, snatching the bottle away from him. "It's part of my therapy. See, I lost my temper on the highway once and bumped another car off the road into an overpass. Killed a kid. Now I have to go a whole year in rehab."

"And *this* is your rehab?" he said, waving at the long bar.

"Yeah. All of it—the bar, the people, and you. My year in hell. Three hundred and sixty-five good days without screwing up and I'll be out of here. I can wish anybody dead just by thinking about it, but then everything turns red and I have to live that day all over again."

The bartender reached across the bar, grabbed for my beer bottle and pulled it out of my hands.

"I'm not done with that!" I said.

"You *are* done tonight. Now get out of my bar. At this rate you'll be in rehab for life. Go straighten yourself out."

I wished him into a grimy puddle and he splashed up onto the bottles lining the back of the bar. No bartender would have made that remark about being a lifer. It must have been one of the wardens jumping in and speaking through him, or perhaps some software psychologist telling me how to behave. I hated when they did that. It broke the illusion that I was in control of the situation.

But of course he was right. The world was ruby red and I was in a rut, almost three weeks trying to get through just

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this one day. I'd have to knuckle under or I'd be stuck on January thirteenth forever.

It started off well enough the next day, and I let the delivery boy, the old lady and the receptionist survive. I didn't bother Fletcher with hints about leaving on time because I knew it wouldn't do any good. At four o'clock, when he asked me to stay late, I kept my mouth shut and let it pass.

Come 6:30 I was still at my desk comparing one set of computer printouts against another, when an old, black cleaning lady came by to empty the trash.

"Say, really burning the midnight oil, huh?" she said, while transferring the tightly wadded-up balls of paper from my waste basket to her big, wheeled bin.

I tried to ignore her and finish my work so I could go home.

"It sure does get dark early this time of the year," she said, picking up scraps of paper off the floor of my cubicle where I had missed the trash can. "Gotta be careful out there when it gets dark. My son-in-law says I should quit this job because of the hours, but I'm always careful."

"I can't talk," I said. "I have to get my work done."

"Oh, yeah, important stuff, huh? Well, that's one good thing about my job; it's the same thing every day. Never any surprises. Some people don't like work like that but it suits me just fine."

That was it, I'd had enough. How was I supposed to concentrate on my work with that woman babbling on about her useless life? I wished her out of her misery and she fell back into the trash bin where she belonged. Everything went red. Damn, it was so close to the end of the workday and I'd blown it once more. I could almost wish myself dead, but it didn't work that way.

There was no sense in finishing up the ad reports with the day already shot, so I got up from my desk and went straight down to Hannah's. I drank my beers quietly and didn't talk to the bartender or Miss Vodka Martini. There was a pair of younger girls at the far end of the bar, much too young for me really, but what the hell. I walked over and introduced myself.

The girls were a bit tipsy and laughing, and I thought I might actually have a chance with them under the circumstances. When it became obvious that they were really laughing *at* me, I almost wished them burned up in flames. Almost. I chalked it up to their youth and the booze and walked away. A few seats down the bar, Miss Vodka Martini's glass was empty so I thought I'd spar another round with her before giving up for the night.

"Excuse me, miss," I said in my sincerest voice, "you don't know me, but I just wanted to say you're the prettiest woman in this place and I wondered if I might be so bold as to buy you a drink? Is that a vodka martini you're drinking?"

She didn't miss a beat. "Get lost, creep. I'm with somebody."

Well, the day was already lost and the world was dripping red as blood, so I wished the whole damned place dead. Every stinking one of them. The laughing women at the bar, the leering men on the make, the couples dining at the tables, the waitresses and the bartender, all fell dead at my command.

Except one.

She was sitting alone in one of the booths, and when they all keeled over it took a minute for me to realize someone was still breathing. The woman stood up and glared at me. She was a brunette, a couple of years younger than me, maybe a touch overweight but with a nice face, and wearing simple clothes that looked like they were from Sears, concealing whatever figure she might have had.

"I wish you dead," I said aloud.

"Who the hell are you?" she said. "I wish *you* dead."

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"I wished you first."

She laughed. I laughed back. With a room full of dead bodies all around us, we laughed together, and I knew I had met a kindred spirit.

Her name was Mary Lanz, a plain name to go with her plain looks. She was doing a year in hell, too, for shaking her infant son to death in a rage when the kid just wouldn't stop crying. She was also seeing red tonight for having wished the counter guy at a Burger King dead for giving her a burger with ketchup on it when she had specifically asked for no ketchup. That's why she was at Hannah's. She said she drank too much when she was depressed.

It was creepy yet fun, the two of us sitting there in the bar surrounded by so many fresh corpses, laughing about the ways we'd both wished people dead and how many days we'd wasted. Then she said she had to go.

"Will you be back tomorrow?" I asked.

"I don't know. It depends on how well I do. Not tomorrow. Today, again. January thirteenth." She looked about at all the bodies and shuddered. "I guess we'll both be living this one over again."

Yet another January thirteenth came, and I was in a better mood than usual. The newspaper delivery guy, the old lady at the train station, the receptionist, and even Fletcher all lived this one out. At 6:30, I was polite to the busybody cleaning lady, and eager to leave the office and see if Mary was at Hannah's again. I poked my head in to Fletcher's office and the stupid get-a-lifer was still in there.

"I gotta go, boss. It's getting late," I said.

"Well, if you're finished balancing those advertising reports—"

"Just a couple more pages to go. I can take care of them first thing in the morning before it gets too busy."

"No, Rick. Not tomorrow. Today. You're not going home until those ad reports are finished, like we agreed."

"Agreed? I didn't agree to anything. You just said I'm staying, but I really have to go. Someone's waiting for me."

"I'm sorry but—"

I wished the prick would explode. And he did, all over me. I was spattered with a light sheen of blood and gore, and everything turned doubly red as the crimson curtain descended. I cleaned myself up as best I could in the lavatory, but my clothes were ruined. Back on the floor, a couple of other poor saps were also working late, so I wished them a gentle death and then took a shirt and pants from the one who was closest to my size.

Mary was still waiting at Hannah's.

"How'd you do today?" I asked her.

"It's all red," she said. "I nuked the twerp at the supermarket cash register when he stopped to gab to the customer in front of me. It was supposed to be the express line. Hey, you hair's all stuck together. What's that all about?"

"You don't want to know," I said. "Everything's all red for me too. I had to stay late at work and I was afraid I'd miss you. The boss didn't see things my way so I took care of him."

"Hmmm. Nobody's ever killed someone over me before," she said with a sly smile. "That's, um, nice."

"I swear, that boss of mine is gonna keep me in rehab forever," I said. "I've been stuck on this day for ages, and mostly because of him."

"It's my sixth time around on this one," she said.

"I've got you beat by a mile. Try twenty."

"Oh my. That's twenty years in rehab if you keep this rate up. You'll be an old man by the time you get out."

"*If* I ever get out. Maybe this is it for me. Maybe I really am just a lifer."

"Well, it *is* the thirteenth of January. You've gotten past twelve days so far."

"Mary, I've been in here a hundred and eighty days or so, and I'm not even half

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past January. This rehab thing just isn't working out for me. It's like they fix each day up with annoying things to set you off on purpose, and then they make it so easy to fail by just wishing someone dead."

She nodded her head in agreement. "But I've heard some people do a year of rehab *in* a year," she said. "That's probably too tough for me, but I'll get out eventually."

Mary grimaced and curiously started squirming in her seat.

"Got ants in your pants?" I asked.

"They're zapping me. I can feel it tingling."

I knew the feeling. The wardens electronically stimulated the rehabber periodically with electrodes to keep up the muscle tone, so the person wouldn't be a cripple from inactivity when the year was up. Or two years. Or however long it took.

"I wonder how many of the other people we pass by throughout the day are also in rehab, instead of just sims," I said.

"One way to find out," Mary said. "We can wish everyone we see dead and see who's left standing. But I don't think there are too many of us, because we're all spread out on different days."

"But I found you," I said. "What do you mean?"

"Well, if I get through tomorrow okay and you wish someone dead, I'll move on to the next day without you."

"I guess. But if I came to Hannah's at the right time, you'd still be here waiting, right?"

"No, I don't think so. For me, it would be January fourteenth while for you it would still be the thirteenth. Like we were in a different . . . space or something."

"Program," I corrected. "It's all just software. We'd be running in different computer simulations, a different one for each day."

"So if you *did* see me," she said, "maybe I'd just be another sim, while the real me was ahead of you by a day."

"But if we both behaved ourselves and didn't wish anyone dead, we'd move on to the next day together?"

"Yeah, that's what I think," she said. "Want to give it a try? Think you can make it through tomorrow without killing someone?"

"I don't know. I haven't had much luck so far."

"Me either," she said. "Today's all shot to hell."

"See you tomorrow?"

"Today. Again. Whatever."

"Be good."

I tried, I really tried the next day, but it was just too hard for me. It was 7:45 by the time Fletcher let me leave, but I wasn't seeing red when I finally exited the office. I had made it through the whole workday, and was rushing to Hannah's, hoping that Mary would still be there waiting for me. I had to catch her before she left or I wouldn't know if she had been able to avoid seeing red today, too. If she had failed and wished someone dead while I made it safely through the day, I might never see her again, at least not as a real person instead of a sim.

In front of Hannah's was a frail-looking bum with his bony hand out begging, "Dollar for a cup of coffee, mister?"

I tried to push by him and get into the bar, but he was standing right in front of the door, and I had to yank him out of the way to open it. The bum stumbled forward, staggering across the sidewalk and into the street while I slipped in through the door. Outside, there was a screech of car brakes and a thudding sound and the inside of Hannah's turned blood red.

I turned around and opened the door a crack to peek out at the street. The bum had fallen in the gutter and been hit by a cab that was trying to squeeze around a bus. I swear it was an accident. I had just meant to get the old geezer

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away from the door, but the rehab scorekeepers had chalked it up as another kill for me.

Inside, Mary was still waiting in her booth. This time she had a baby in a daycradle with her, so I knew she had behaved herself all day. There would have been no point in bothering with the kid if she was seeing red. I explained how I had been so good all day, and had just lost it walking in the door to Hannah's.

Mary turned around and promptly dropped one of the waiters, to even us up.

"Okay, Rick, you were almost there. Do you think you can hold it in just a little bit longer tomorrow?"

"Yeah, I'm sure of it."

Mary's baby was pretty cute, even if I knew he was just a sim.

It was January thirteenth again, my last I hoped, and I was determined to make it through the day. I did everything right, and when the bum in front of Hannah's asked me for a dollar, I gave him a twenty.

Mary was there with her baby, and she had made it through the day okay, too. We went home together to her place, being very polite to everyone, even when they really deserved to die. I played with Mary's baby before she put him away for the night and had fun doing it. And then Mary and I went to bed together. And we were very polite to each other.

In the morning I woke up in Mary's bed. It was January fourteenth. Only 352 more days to go.

It took longer than I thought to get to work from Mary's apartment, and when the receptionist made a crack about being late, I wished her dead without even thinking. I called Mary on the phone and told her how I had already messed things up. She said not to worry, that she was thinking about blowing away the garbage men who were making a terrible racket and waking the baby. We would try again tomorrow.

And we did. It took a couple of tries to get it right, but we got past January fourteenth. And then the fifteenth and the sixteenth. I closed out my place on Staten Island and moved in with Mary and her baby. The days got easier and easier after that. Having another real person depending on me seemed to make all the difference. Once in a while, one of us slipped up and killed somebody, but whenever that happened, the other one just wished someone else dead and we kept in sync.

The days became weeks. The weeks became months.

On the Fourth of July, as we were watching a fireworks display, I asked Mary, "What are we going to do when we finally get out of here? When the rehab's over?"

Mary looked slightly puzzled, then worried. "I haven't really thought much about getting out. In the real world, you know, I . . . I killed my baby."

She started crying, and I wanted to wish myself dead for bringing it up. The baby we were raising in rehab was just a sim, and when rehab was over the little guy would be gone. He was a cute kid and I would really miss him myself. It was like I was starting to think of that baby as my own.

"You know," I said, "when we both get out, we could maybe start a family together. A real family."

"Is this . . . do you mean . . ."

"I do."

It was New Year's Eve and we were celebrating in grand style. We had invited a whole bunch of the sims, Fletcher, Lucy Moore, and some of the regulars at Hannah's, over for a big party at our place. Even though we knew they weren't real, it just seemed like the right thing to do—a house full of people, real or otherwise, to help us ring in the New Year and say goodbye to rehab. It was our graduation bash.

We put the baby, actually a toddler by now, to bed around nine o'clock and

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kissed him goodnight for what we knew was the last time until we had our real baby. One of Mary's sim friends stupidly asked if she was putting on weight, and Mary said yeah, probably. Fletcher spilled a drink in my lap and I laughed it off.

And then we were counting down to midnight. Mary and I sipped our champagne and kissed before the count got down to zero, promising each other that we'd see them soon on the other side. And then it was midnight.

I woke up in a gel bed, and a warden was removing the wires from my head, a sharp little sting as each one popped off. It was quite painful. I laughed.

The warden said, "Six hundred twenty-two days altogether. Not too bad at all for a year's sentence."

I tried moving my arms and legs, which were stiff and tingling.

"There was someone else in rehab getting out today," I said. "I'd like to see her when she's up and about. Mary Lanz is her name."

The warden made a face and held out a pair of pants for me to put on.

"She and I are planning to get married and start a family," I said.

He handed me a shirt, belt, socks, the whole outfit, without a word.

"When can I see Mary?" I asked.

The warden started writing on a clipboard. "There is no Mary. It was just rehab."

"No," I said, "she was in rehab, too, just like me. She's getting out today."

"There *is* no Mary. Everything you saw, everyone you met was all part of your rehab."

I wished him dead. But real life didn't work that way, and he kept scribbling on his clipboard. My fists clenched and I started to raise them to choke the life out of him. But I stopped and dropped my hands to my sides before he noticed.

"Here's one hundred dollars and directions to the bus depot," he said, handing me a manila envelope. "Sign here, and I hope to never see you again."

"Thanks," I said through clenched teeth as I signed the paper without reading it.

"You want to kill me," the warden said, "don't you?"

I didn't answer.

"Oh, it's natural," he said. "They all do. But you don't have it in you. Not anymore. You've been rehabilitated, my friend."

I *did* want to kill him. It would have been easy to lash out, grab his throat and throttle him. Surely the rehab hadn't worked nearly as well as the warden thought it did, but I had reason to hold up.

Mary *was* real, I was sure of it. Somehow, some way, she and I had been in the same rehab, and I would find her. And if the Mary I knew was just a sim, well, that sim had to have been based on a real person. And I would find her, I vowed, wherever she was. Whatever she was.

And if that didn't work out, I could always come back and strangle the warden and get sentenced to more rehab, so I could be with my Mary again.

I took the bus from Ossining back to New York City and went straight to Mary's apartment. Someone else was living there, but I pestered the woman in the rental office and she admitted that a Mary Lanz had lived there five or six years ago. She didn't have a forwarding address, but I was happy, nonetheless. It proved that Mary was a *real* person. Now all I had to do was track her down.

At the public library I got on one of the free computers and searched through public records and directories for Mary Lanz. There were a dozen people with that name throughout the country, and I called each one up on a pay phone, using up most of my remaining money, but none of them was *my* Mary. I searched the online newspaper archives and came up with the case of

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one Mary Lanz, who had shaken her baby to death and been sentenced to a year in rehab. Through court records I found out she had successfully served her time and been released, over five years ago. The Mary I knew had been in and out of rehab long before I'd even started my own sentence.

After that, the trail grew cold. On the public access computers I searched marriage records across the country, thinking that maybe she had a different last name now, but of the three Mary Lanz's I tracked down that way, none of them panned out when I called on the phone. I reluctantly checked the obituaries, too, and was relieved when the two Mary Lanz's who had died in the past five years didn't match up with my Mary. It seemed after paying her debt to society that she had simply disappeared off the face of the earth.

I checked Hannah's. The place wasn't the same as I remembered it in rehab. Instead of the seedy no-nonsense watering hole, this Hannah's had gone upscale, with teak paneling, stained glass Tiffany lamps and lots of ferns—hardly the kind of place Mary would frequent. But I wandered in, looking up and down the row of booths, hoping for a glimpse of her sitting there, waiting for me as if nothing had happened. I wasn't even a dozen paces inside the place when a large man wearing a white shirt that looked as if it could barely contain his overdeveloped muscles stepped in front of me, blocking my view of the rest of the booths.

"Can I help you, buddy?" he said in a tone of voice that let me know he was *not* my buddy.

"I'm trying to find a friend," I said. "Her name is Mary."

The bouncer looked me over with arms akimbo and an expression of disbelief on his face. No wonder, since I had been living on the streets for over a week and badly needed a shave, shower, and a set of clean clothes before I could fit in at a pretentious barroom like that. I tried peeking around the bouncer's formidable biceps to see if I could catch a glimpse of Mary at one of the booths.

"Hey, pal, you got any money?" the bouncer said. "Because if you ain't buying, you're walking."

I reached into my pocket like I was going to pull out a bankroll, but there was just a wad of notes I had taken at the library, and I shrugged my shoulders like I had misplaced my wallet. The bar patrons were starting to notice, so I turned around and left before it got ugly.

After a couple more weeks of living at the library and homeless shelters, I was able to clean myself up a bit with the help of a state-run employment agency, and I took a low-paying mailroom job at some sleazy midtown import company that didn't ask too many questions about my background. Another couple of weeks later, when I cashed my first paycheck, I went back up to 53rd street to celebrate my minor victory at Hannah's as a paying customer. Luckily, the bouncer didn't recognize me from our previous encounter.

And there she was. Mary. In the same booth in back where I had first seen her. My first thought was that it couldn't be her—she looked too old. Some of that was due to the fact that the sim I knew had been modeled years earlier when she was in rehab, but that didn't account for all of it. She was sitting in the booth alone, drinking. Hard. Three empty glasses littered the table before her and another was in her hand. She didn't drink it like a lady, either; she pounded it down like a drunk.

"Mary," I said, walking over to the booth. "It's me, Rick!"

"Am I supposed to know you?" she said in a slurred, sarcastic tone, between gulps of booze.

Of course she didn't know me at all. The Mary I loved was only a model of this person, from years earlier. But I could see through the whiskey haze and

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the rough edges that had built up over the years that it was her. My Mary was in there.

"You and I have something in common," I said.

"Oh, yeah, what's that?"

"Well, for one thing, we both love your kid."

Her eyes, which had brightened for a hopeful second now went cold. "My baby's dead. Who the hell are you?"

"A friend," I said. "From rehab."

At the mention of rehab she looked away in embarrassment.

"Yes," I said, "I was in rehab too. And I met someone just like you."

Mary looked like she was about to cry, and she lifted the glass to her lips again and drank deeply.

"You once told me you drank too much when you were depressed," I said. "I wish you wouldn't do that anymore."

She sniffled and looked me in the eye. "Yeah, well, maybe I wish you dead."

I snorted a laugh and took the glass from her hand and placed it at the far end of the table. "I wished you first," I said, smiling at her. "Please."

Mary had her problems, just like all of us, but she just needed someone to love. Someone to depend on. Just like I had needed her. It would take time gaining her trust and then her love, and there would be setbacks, just as there had been with her virtual incarnation. I would do what was needed to make it happen. I had the time.

A tear rolled down her cheek, but she finally smiled back. It was a nice smile, just as I remember it. That was when I knew for sure I could rehabilitate her.

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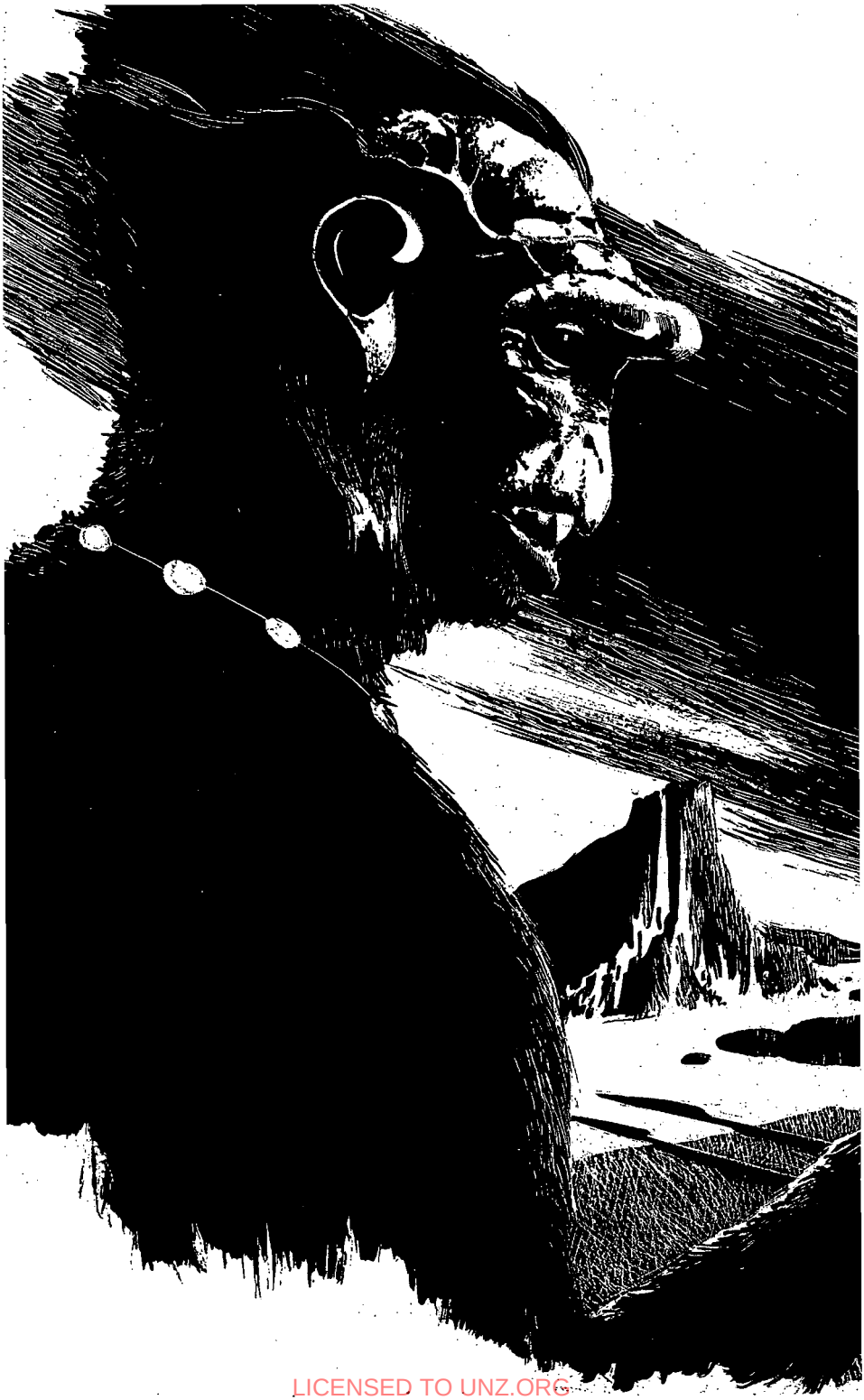

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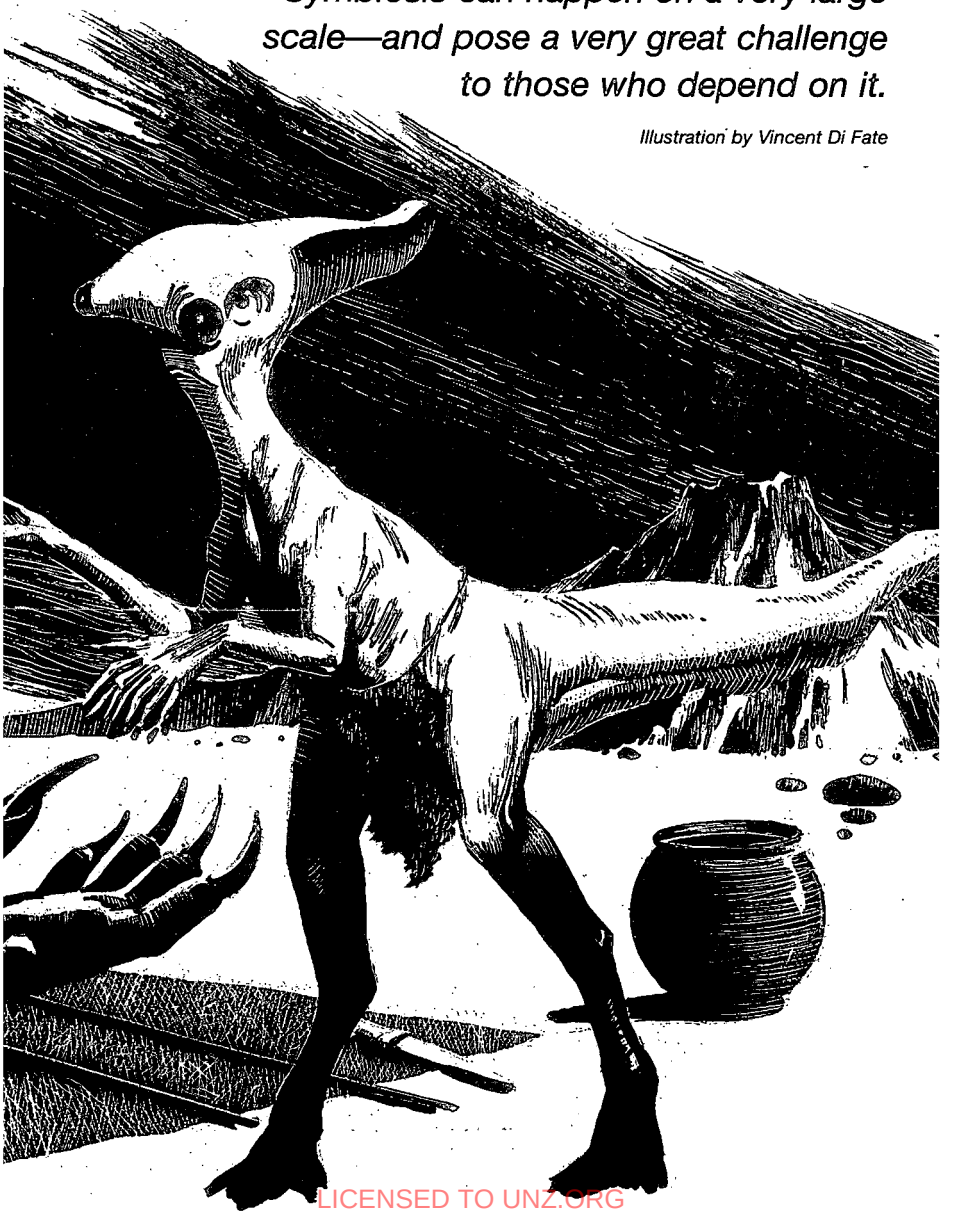
Dave Creek

A GLIMPSE OF SPLENDOR

Symbiosis can happen on a very large scale—and pose a very great challenge to those who depend on it.

Illustration by Vincent Di Fate



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We see life persistent and intrusive—spreading everywhere, insinuating itself, adapting itself, resisting everything, defying everything, surviving everything!

—Sir John Arthur Thomson, biologist, 1920

7918 B.C.: As most of humanity was undergoing the Agricultural Revolution, the universe handed the planet Splendor a death sentence to be executed over ten thousand years later.

A star sixteen light-years away, which Humanity would name Aeolus, was about to die. It was a blue body over four times Sol's mass. It had used up the hydrogen fuel in its core and must fuse successively heavier elements to keep the nuclear flames burning—helium, then carbon, oxygen, magnesium, neon, silicon, sulfur. Its core grew hotter, its outer layers expanded and cooled.

The star became a red giant, then finally—disaster! Its outer layers blew away in a titanic supernova explosion. A nebula of hot gas expanded at thousands of kilometers a second. Those gases would reach Splendor within ten thousand years, and its high-energy particles would increase the intensity of the cosmic rays bathing the planet a hundredfold, bringing death for most species and a soaring mutation rate among survivors. Those in narrow ecological niches would suffer the most.

Meanwhile, Splendor's two intelligent species lived in narrow ecological niches, indeed.

10,056 years later . . .

The highlander named Ahtenhurat knew the strain of the long journey west must show in his features. His reddish fur was heavily matted, his body gaunt. On his back he bore the burden of a dozen of the furs that were a highlander's stock in trade. About six times a year he ventured out from his safe, frozen homelands to the unnaturally warm realm of the valley dwellers.

Each trip was more of a strain than the one before. As tribal Elder, he thought, I should bring a young one with me next time.

By the time the sun topped the mountain ahead, the snow gave way to marshy ground. The air grew warmer with each step downward into the valley that was his and D'jirar's trading site. A thin trickle of lava flowed from a nearby active volcano into a large basin on one side of the valley.

Ahtenhurat spotted D'jirar near a series of pools of water on the opposite side of the valley. She squatted, motionless, supported by two strong legs. Her skin had a greenish cast and was finely scaled. Her thick tail curled behind her. To her right, two smaller versions of her species swam in one of the water pools. They weren't the valley dwellers' young, but the males of her species.

D'jirar stood. Her lips and teeth struggled to speak the highlander tongue. "Glad you are well, my friend *Agh-enhur-agh*."

Ahtenhurat said, "You strengthen my hearts." D'jirar unwrapped a long slender sheath, eight fingers working with the practiced dexterity integral to her craft. The knives, spears, and tools lay revealed. D'jirar picked each one up, reveling in their artistry. Magnificently detailed images glorifying the valley dwellers' gods were carved into the point of a spear or the bone handle of a knife or scraper. Some of those carvings combined images of animals such as quicksleep or burrowers with others clearly patterned after highlanders, in a manner which Ahtenhurat found unsettling. It had often been suspected the valley dwellers looked upon highlanders as somehow godlike. He'd never risked asking his friend about such matters.

Ahtenhurat's short, thick fingers struggled with the bonds of his own pack. Finally the furs his tribe had produced lay

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between them. D'jirar knelt to examine them. She looked up at Ahtenhurat and hissed quietly, which he knew indicated pleasure. Picking up the furs, D'jirar stood, then leaned back on her tail.

This was a pattern played out as far back as Ahtenhurat's tribe could remember. He wrapped up the bundle of spears and tools and slung them across his back. "Good health to your females," he said.

"Good hunting to you," the valley dweller said. Ahtenhurat started to trudge back the way he had come, the marshy ground and his old bones making for slow going.

D'jirar basked for a selfish moment in the lingering exultation Ahtenhurat's presence had evoked. Her gaze rose toward the setting sun. The two males climbed out of the pool and shook themselves free of water. The sick one seemed to have gained energy from his play, but D'jirar was still pessimistic about his chances for surviving the journey back to her village. The tips of some of his scales had turned almost white, and several had peeled off. His breathing was ragged and shallow.

D'jirar *huffed* a sharp breath as the sun fell behind the western ridge. She'd brought five males on this journey. Three had died; that was nature's way. Tonight the pair remaining would have their chance to fertilize D'jirar's eggs. If they succeeded, they would receive those eggs back within their own bodies for gestation. It was all worth it to keep the hope of a female birth alive. Females were the intelligent sex among valley dwellers. Sometimes it was hard just keeping males out of lava pits.

D'jirar did not wish to mate now. She gathered the furs Ahtenhurat had brought and bound them to her back.

The sick male faltered; D'jirar laid the furs back down. Perhaps a few moments' rest would suffice. D'jirar knew others of her village would ridicule her for such devotion, but they did not share her motivations. Unlike most of her fellow villagers, D'jirar *had* a sister, she knew the joys of growing up with another female, sharing life together. She knew what was at stake.

Her brief time with the highlander Ahtenhurat always made her purpose clear. The highlanders could not survive for long within the volcanic areas. The valley dwellers, however, could live nowhere else. They'd learned the techniques of forging the foul-smelling flow from these reaches into tribute to the gods. In return, the gods, in the form of the highlanders, blessed the valley dwellers with their presence and with their gifts of furs.

This was her life, solid and unchanging.

Mike Christopher didn't realize he was walking so swiftly away from his old starcraft, the *Stanley Weinbaum*, and down the embarkation corridor of his new posting, the *Asaph Hall*, until he had to stop short to wait for the inner airlock hatch to slide open. The two ships were joined together in orbit around the planet Splendor.

Not so eager, Mike told himself. Just because the rest of the galaxy's about to open up for you. He hitched the bag containing his few belongings higher onto his left shoulder. He would be the *Hall*'s First Officer and Chief Contact Officer. It was a big move. And you never knew how people would react to their first glimpse of an artificial Human.

The hatch slid aside, revealing two women standing in a narrow corridor. He recognized the nearly two-meter-tall, redheaded, fortyish woman as *Asaph Hall*'s captain, Rosa Sandage. Mike put down his bag and stepped forward with his hand outstretched as the hatch slid shut behind him. "Good evening, Captain Sandage."

The captain took his hand in both her own. Her grip was firm but welcoming. "Pleased you're here. And it's Rosa." Her eyes never wavered from his own dur-

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ing that greeting, yet her piercing gaze made Mike felt as self-conscious as if the captain had stepped back to look him up and down. He felt about a third of his thirty-four years.

And what was her impression of him, with his mixture of Human traits, his bright blue eyes with epicanthic folds, his tightly curled, dark brown hair, his fair skin? Her demeanor revealed nothing. Mike said, "Rosa, then." Mike looked past her to the other woman and her round face, pert nose, brown eyes. She stood and just—*looked* at him with her hands folded before her, head slightly tilted, and mouth curling upward ever so slightly as if from a private joke. Then her eyes flashed warmly at him and the smile became full-fledged.

The woman said, "He'll do."

Mike felt the blood rush to his face. But Rosa smiled. "Tell the *Weinbaum* we've received their former crewmate, give them our regards, and prepare to cast off."

The unidentified woman shook Mike's hand. "I'm Linna Maurishka."

That explained it. "The empath," Mike said.

Rosa said, "I was going to say you'll have to excuse Linna, but you don't. The rest of us are used to her." Rosa grabbed up his bag before Mike could protest. "I'll take this to your cabin."

Linna said, "And we're off to the viewing stage."

Rosa went one way with Mike's bag, and now he was rushing the other way to keep up with Linna.

The viewing stage was a room nearly four meters tall and five wide. "Have a seat. This was just a couple days ago." The output was from holographic nanite uplinks peppered from orbit onto a trading site a valley dweller and highlander favored. "The furry fellow's the highlander—"

"Yes, I know that much."

"Sorry. His name's Ahtenhurat. He's Elder of his tribe, their day-to-day leader. The valley dweller's called D'jirar." The ship's computer translated the few words spoken as the two greeted one another, made their trade of furs for metal implements, then departed. Mike watched, fascinated.

Mike already knew the basics about Splendor. Its primary was Pinpoint, a yellowish-white F7 star. Splendor orbited Pinpoint about half again as far as Earth did from its primary, counterbalancing Pinpoint's luminosity of 2.4 Suns. With the amount of energy a planet received falling off in an inverse-square proportion to distance, Splendor ended up a colder world than Earth.

Just a little colder, and Splendor wouldn't have supported either species. The narrow band of ice-free landscape at the equator was mostly forest. Faint points of red marked individual volcanoes and their nearby pools of molten metal, oases of warmth for the valley dwellers.

Already, Mike felt a kinship with these beings who would either be displaced from the only world they'd ever known, or left there to die. He'd left Earth for the spacing life when he was twenty-one.

The images faded. Mike sat quietly, right arm folded across his chest, left hand against his chin. "No luck finding a planet compatible with both species?"

Linna shook her head. "No other world that could accommodate both an arctic-adapted species and one accustomed to living in volcanically heated valleys. But we've found separate worlds for them. The planet for the highlanders is in the Socrates system, not as cold as Splendor, so they'll have to live closer to the poles. It has sufficient room, however, for them to live the semi-nomadic life they're accustomed to."

Mike asked, "And the valley dwellers?"

"Kardashev's system. A planet with an expansive region on its largest continent where the valley dwellers should feel at home. Volcanoes, lava, hot springs, all in abundance. It's quite fertile and should be an ideal world for them to practice agriculture."

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Mike stood. "We'll wait until Ahtenhurat and D'jirar head out on another trading journey. Then we'll make contact."

Two months later. . . .

Ahtenhurat protested when Ugarthawin, the tribemate he'd picked to be his successor on the trading journeys, insisted that he carry all the furs. They stood underneath a clear, cool sky, next to Ahtenhurat's shelter. "It is my responsibility," Ahtenhurat said.

"With respect, Elder, I must learn to pace myself while carrying the burden. Is that not correct?"

"Yes, it is, but—"

"Elder. I must insist." Ugarthawin bundled the furs together.

"Then let's get going." Ahtenhurat and Ugarthawin started across the rocks and ice. As they reached the perimeter of their encampment, several of their tribemates stood before them. Everyone bore a spear or knife.

Ahtenhurat turned his attention toward one he recognized, a constant rival named Eluharobak. "You have come to wish me well?"

Eluharobak sneered. "I have come to convince you to ascend to the rank of Eldest, as you should by all our traditions." The tribe's Eldest, its ceremonial adviser, had died many days before, but Ahtenhurat had refused to ascend to that position, as was the custom. His tribe needed him still as Elder, to pass on the trading ways.

"You do not interpret our traditions for the tribe. As Elder, *I* decide such matters."

Eluharobak stepped forward. "I do not wish evil of you. I look forward to your counsel as Eldest."

Ahtenhurat said, "You wish counsel you will ignore. You desire an Eldest who might find himself before the tip of a spear one dark day." He started forward, but suddenly was knocked to the ground. Yells, screams—a cry of agony—a body fell to the ground with a dull thud, and Ahtenhurat covered his head against the press of the crowd. Someone tripped over his body and fell atop him, knocking his breath away. A large splayed foot covered with dark brown fur barely missed his face.

Hands reached under Ahtenhurat and helped him stand. The crowd cleared before him. Eluharobak held a bloody spear over Ugarthawin's still body. "I had to do it," Eluharobak pleaded. "He attacked me."

Ugarthawin lay face-down, his blood a slash of bright red against his dark gray fur, and a widening, steaming puddle in the packed snow beneath him.

One of Ahtenhurat's allies, a tribemate named Indirogar, spoke up. "Ugarthawin *did* attack him. But I will kill him, all the same."

"*No*," Ahtenhurat said. "Hold on to me. I might fall." He wanted an excuse for Indirogar to stay his hand.

Eluharobak wiped the blood from his spear by rubbing it against the fur of one leg—first one side, then the other, slowly, with no implied threat. He leaned on the spear again. "Forgiveness, Elder."

Ahtenhurat said, "I did not wish him to attack you."

"I believe you, Elder. I know of Ugarthawin's impulsiveness from our days together as hunters. Please continue on your journey. I will not allow further violence while you are away."

Ahtenhurat settled to the icy ground. He feared that by the time he returned, many of his tribemates and his entire way of life might have died.

D'jirar looked out across the vista of sea and ice that was the Strait of Ancestors. She stood with her sister L'hareni, whom she had picked to become the new trader with Ahtenhurat, and four males. Close to shore, the layer of ice seemed thick enough to support them all. Farther out in the strait, large ice floes, wide and flat, glided silently over the water.

Scattered among the floes were gigan-

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tic icebergs. Fresh-water runoff rich in nutrients poured from them into the sea water of the strait, attracting schools of wingfin. Those fish, in turn, brought flocks of flamebirds that preyed upon the wingfin.

Many of D'jirar's village had died crossing this strait. She cast such thoughts aside and stepped onto the ice. L'hareni and the males followed. The wind was picking up and clouds were moving in.

L'hareni's voice revealed a deep worry. "It's so far across. D'jirar, I'm afraid."

"You may return to the village if you wish."

L'hareni looked hurt, as D'jirar had intended. "I would not leave you now," L'hareni said.

"You make me proud. At times I will tell you to step exactly where I do. At other times you must *not* step as I do—you must take a different route because the ice is too weak, or a floe too small to hold both of us."

"What of the males?"

"Two must follow you. The other two will keep with me. Do not risk yourself if one of them falls." D'jirar led the way out onto the ice. She couldn't help but notice L'hareni's quickened, nervous breathing, and the males' chittering and hissing. As they neared the edge of the ice, waves generated by passing floes caused it to undulate slowly beneath them.

An almost unbroken plain of pack ice was spread out before them. The separate floes took individual paths within that plain, grinding and pushing against each other. And the sound! One moment D'jirar was reminded of the roar of an active volcano, the next of the plaintive cry of a wounded burrower.

D'jirar saw a large floe, eight or more times as wide as her own height, broad enough to support them all, growing nearer. "Jump as I do, as far into the center of the floe as you can."

The floe came nearer still, pushing smaller chunks of ice ahead of it with a sharp screeching sound. "Now!" D'jirar yelled, and jumped. The floe sagged slightly on one side under her weight. She sprinted toward the opposite side as L'hareni and the males jumped over. "We need to spread ourselves out." Enough of its mass was beneath the water that the floe wouldn't upend, but D'jirar didn't want any of them to slide off. "Now we look for the next opportunity. Are you ready, sister?"

"I am."

Then it was a matter of gathering the right rhythm. Wait for the right moment, jump, wait again. The actual jump was the easy part. It was the waiting for a floe of sufficient size, the judging of relative speeds and direction, that grated on tender nerves as jarringly as these blocks of ice grated against one another.

They weren't even halfway across when D'jirar realized the danger they faced.

They were much farther from the shore than they should have been, and much farther down the strait. Traveling on ice floes, it was easy to lose all sense of motion relative to the passing shoreline. The current had sped up, somehow, and was taking them through the Strait of Ancestors much faster than it should have.

Peering ahead, D'jirar saw that an iceberg, one even more enormous than the giants that usually plowed their way through the strait, had lodged against a small promontory. Floes were piling up against it. The familiar grating sound of ice against ice grew louder by the moment. This side of the strait was becoming so clogged with pack ice that the normal course of the waters had been disrupted; the strait had effectively been narrowed here, causing the current to surge through more rapidly. If more bergs or even enough ice floes piled together, the entire strait could be blocked; destruction would continue on a massive scale, possibly for days until the onrushing waters broke the jam apart.

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The booming of the pack ice against the trapped berg reverberated more insistently across the waters. Unless D'jirar acted quickly, the floes she and L'hareni stood on would be crushed.

Looking back upstream, one iceberg in particular caught her eye—it was just far enough out in the middle of the strait that it would likely pass by most of the blockage. If she and L'hareni acted fast, they might be able to reach the ice floes just behind it.

D'jirar turned and jumped across to L'hareni's floe. Her males, after a brief hesitation, followed her. D'jirar had to raise her voice to be heard over the thunderous sound of the ice piling up against the giant berg. "That iceberg will be our salvation. It should miss the one that's caused the blockage. If we can climb onto an ice floe behind it, we might be saved."

Back to the familiar rhythm—wait, judge the distance, jump! If my sister survives today, she thought, she will truly be worthy of taking my place.

The berg that might clear a path for them was silhouetted against the sun, which had just begun its rapid descent into the western sky. D'jirar turned back to check on L'hareni, and saw that one of her sister's males had slipped into the water. L'hareni was reaching out across a gap between two floes, trying to rescue him.

D'jirar rushed back and pulled L'hareni to her feet. The male, its arms flailing vainly, slipped beneath the water. D'jirar held fast to her sister's arm as they continued across the ice. The three remaining males followed, sticking close by.

The berg that might save them scraped against ice floes jammed against the other berg blocking the strait. Its unstoppable mass destroyed one floe after another—ice tilted up in giant sheets or was instantly pulverized as the berg bore blindly onward. D'jirar looked for floes in its wake solid enough to take them past the blockage.

D'jirar looked out across the swirling waters in the iceberg's wake. The booming grew louder and louder, resounding across the waters, a physical presence. D'jirar felt the pounding through the ice beneath her feet. For a terrifying moment, she feared they might have to swim for a floe. Then one appeared, swept into the berg's backwash.

"Jump for that one!" D'jirar shouted to L'hareni. She removed the sheath with their provisions and aimed for the center of the floe. It struck, slid, stopped.

Her sister held her sheath tightly, refusing to give it up—the pack that held their fragile pottery. D'jirar snatched it out of L'hareni's grasp and tossed it across the watery gap, hoping the pottery wouldn't shatter. Then she leaped—

—and landed awkwardly, her legs sliding out from under her. Her head struck the ice, and she cried out in pain, but made herself rise.

The ice floe began to tilt. She forced her eyes open and saw L'hareni standing over her. The booming drowned out her sister's words, but they held on tight as D'jirar caught her breath and regained her bearings.

The three males jumped, but their little legs were too weak to propel them all the way onto the floe. They splashed into the frigid, raging waters, swimming furiously. One was crushed between two large floes. The numbing cold sapped another's strength. It disappeared beneath the water.

The last male had more fight—D'jirar helped him onto the floe. She and L'hareni picked up their sheaths. They had to keep moving quickly across the strait. The current was taking them through the channel much faster than usual. They could end up swept to sea.

Now they passed the other iceberg, the one causing the blockage. It sounded as if mountains had come to life to walk the earth. As the two valley dwellers ran, they covered their ears against

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the unbearable roar of the massive pile-up of ice.

Then came another danger, as their floe swayed back and forth, helpless against the force of the waves. D'jirar instinctively fell prone, spreading her limbs as wide as she could. L'hareni and the sole remaining male mimicked her. The male's eyes were wide with fright.

The booming was so loud D'jirar would have sworn it originated within her own head. She, L'hareni, and the male were showered with shards of ice. Finally, just when D'jirar thought it would go on forever, the booming began to fade. Their floe sailed smoothly across the waters.

Then they stepped onto shorefast ice. D'jirar hesitated, examining it carefully. "What is it, sister?" L'hareni asked, as she held the skittish male back.

"This ice may be too thin to support all of us at once." As D'jirar eased forward, the ice sagged. "It will support one at a time," she said, and stepped across until she reached solid ground. She thanked the gods silently and waved for L'hareni and the male to start across. "Go slowly," she told them. Watching her sister negotiate the same path as her own, she marveled at how much courage she demonstrated.

D'jirar concentrated so intently on L'hareni that she didn't see the male panic until it was too late. Desperate to get to shore, the male sprinted across the ice through a thin area D'jirar had avoided.

That's when L'hareni made her own error. She rushed forward to grab the male. "No!" D'jirar shouted.

The ice that supported the lighter male broke through under L'hareni's weight. Both slid into the freezing waters.

They were too far from shore; D'jirar could only watch in horror as they disappeared. Her wails echoed across the water.

Mike was in his quarters examining a holo of Splendor, postponing his work on a report to Rosa, when the door chime sounded. "Holo off," he told the computer. He sat up in his bed, said, "Open," and the door slid aside.

Revealing Linna. She grinned as if she were the only repository of a fantastic secret. "May I come in?

"Well . . . sure," Mike said, stepping aside to allow her into his cramped quarters. "I haven't gotten to see you much the last few days."

Linna's smile turned mischievous. She said, "That's been on purpose." She waved away Mike's objections even before he could open his mouth. "I needed to . . ." She wagged her head back and forth as if trying to shake the right word out. " . . . decompress, I guess. I needed to save up some time in the ol' emotions bank."

Mike swallowed slowly. They'd grown closer than he could have imagined in the past two months, given the way their relationship began that first evening aboard the *Asaph Hall*. Linna opened her arms and took him into a warm embrace, then offered her face up for a long kiss. "Can you tear yourself away from that damn report?"

"Rosa's expecting it in the morning."

Linna kissed him again, then her expression turned serious. "Not any longer. There's a problem down on the planet. It's time for you to go down there."

Ahtenhurat looked westward, where the sun still reddened the thin clouds at the horizon. He'd caught a burrower for his supper, and its lingering taste was still sharp. He placed his sheath of furs on the ground between two large boulders. He was about to place his head upon the furs when his eyes caught a movement below, toward the west. The crosswinds weren't bringing him a scent. Ahtenhurat rose from his rocky bed and waited.

Ahtenhurat saw that the creature wore furs like a valley dweller, but was closer in body form to a highlander, as it

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stood stiffly erect and had no tail. Its naked features were an odd shade of brown that Ahtenhurat had never seen other than on a tribemate's fur or the rough bark of dried, dead hardweed. Ahtenhurat's hearts raced, and he forced them toward calm. He started down the ridge, careful of the precarious footing. Suddenly the creature spoke, and in his own language!

Ahtenhurat squinted in wonderment for a long moment, then asked, "Did I hear you correctly, strange one?"

"I said, greetings to you, Ahtenhurat. Your presence strengthens my heart." The stranger's mouth and tongue seemed to be forming his words with some difficulty. He spoke more fluently than D'jirar or other valley dwellers, but he must still strain to catch the meaning.

"Heart? Surely you mean 'hearts?'"

"My people have only one."

"As a valley dweller would. Yet you are not a valley dweller."

"No, Ahtenhurat. Neither am I a highlander."

Ahtenhurat did not know whether to be fearful. "I am curious about you, stranger."

"My name is Mike."

"Are you armed . . . Makh?"

"I am not. As you would not be, since you are on a trading journey."

Ahtenhurat was surprised anew. "How do you know of such things? How do you know my name?"

"I know many things about your people, Ahtenhurat, and about the valley dwellers. I also know both your peoples are in danger."

Ahtenhurat's stance stiffened. "A threat?"

"I do not cause these events. I only tell you of them."

Ahtenhurat snorted harshly. "I do not believe in prophets."

The stranger . . . Makh . . . held his arms out wide, as if embracing Ahtenhurat's words. "If you hold a bowl out before you and drop it, will it not fall to the ground?"

"A child knows this."

"As we grow closer to winter, does the ice not form farther out to sea?"

"It will do so forever."

"Because I say such things, am I a prophet?"

"You are not. But you could know more of how to deceive than you know of future times." Ahtenhurat looked into "Makh's" eyes, those strange orbs that were too small, not far enough back in their sockets, and were an eerie, icy blue. "We will sit," Ahtenhurat said. He hunkered on a boulder, and watched closely as Makh did the same. "Why do my people know nothing of you?"

"My tribe lives farther away than you can imagine." Makh placed his hands on his knees. "Do you often look upward, at the lights in the sky?"

"The sky-points."

"Do your people ever wonder what they are?"

"I've heard tales for children, full of fantasy."

"They're suns, so far away they seem small. My people know their nature and behavior as your people know how to use the skin of the quicksleep to make a bag, or as the valley dwellers know which bones can be sculpted to make the best and most beautiful knife handles."

"What do the sky-points have to do with me?"

"One such sky-point will, one day, kill all that lives in the world."

"I do not care for tales of fantasy."

"I know this is difficult for you to understand."

"The difficulty is not in understanding. It's in continuing to listen to you at all."

Makh stood up. Ahtenhurat, fearful of his intentions, rose also. "Makh, I'm sorry I've distressed you. You're most interesting. I'd like to speak with you when the sun—or is it a very near sky-point?—rises again."

"That's very perceptive, Ahtenhurat," Makh said. "And thank you for your invi-

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tation. Don't worry, I'll sleep here at the bottom of this rise, while you stay up there with your furs."

Ahtenhurat was embarrassed; he'd indeed been wondering how to make sure both he and his wares would be safe as he slept. "I thank you, Makh," he said. Ahtenhurat clambered up the ridge, finally putting his head down upon the furs. It took some time for him to fall asleep. His dreams were filled with strange, unformed images of a myriad of suns crowding against each other in the heavens.

When Mike awoke the next morning, Ahtenhurat was nowhere to be seen. Panic overtook him, and he scrambled up the ridge, sending stones scattering down the slope.

Ahtenhurat's pack was still where it had been stashed the night before. Just as he reached in his coat for his sensorpac, Linna's voice came through his datalink: "Mike, he's just gone to look for food."

Mike let out a sigh of relief. "How close is he?"

"Less than half a kilometer away, directly north. Headed toward a small quicksleep herd."

Pinpoint was emerging from beneath the eastern horizon. The sky directly overhead was a dark purple, flecked with a hint of reddish clouds. Splendor's higher gravity, about one-and-a-third *g*, had weighed upon Mike's body even in sleep. And he could have sworn that his mouth hurt from the exertion of bending his lips and tongue around the highlander language, even with a datalink protocol to help him.

Mike looked north and saw Ahtenhurat loping toward him, carrying the carcass of a large, brown-furred animal. He rushed forward to help the highlander with his prize—Ahtenhurat's legs wobbled and he breathed heavily. He seemed to hesitate to hand the animal over—did he think Mike would claim it for himself?

Mike grunted under the beast's dead weight. Ahtenhurat had snapped its neck—a bloodless death. The animal's bright pink tongue lolled between two impressively sharp tusks. He held his breath against the stink as he made his way up the ridge and placed the quicksleep on the ground.

"Thank you, Makh," Ahtenhurat said, still catching his breath. He began to rip at the quicksleep's body with his fangs. Blood poured from the quicksleep's carcass as Ahtenhurat ripped flesh from its flank and began to chew.

Ahtenhurat swallowed, then paused. "My apologies, Makh. I felt shame when I did not pass the quicksleep to you right away."

Ahtenhurat swallowed a particularly large bite of quicksleep flesh with an audible gulp. The highlander casually tossed aside a bone and began devouring the meat off another. Between bites he said, "You may share this with me, if you wish."

Linna's voice came over his datalink, its tone urgent. "Don't eat that stuff, Mike!"

She needn't worry. He was trying not to look at the bloody mess of entrails Ahtenhurat was devouring. "I have my own food."

"Hmmph," Ahtenhurat said.

"May I tell you about the sky-point that someday will kill everything on the world?"

"Makh, I enjoy your company much more when we speak of real things."

"This is all too real, Ahtenhurat."

"Makh," Ahtenhurat said, "I will listen so I will have frightening stories to tell the small ones of my tribe."

"The sky-point . . ." Mike hesitated. Ahtenhurat's language didn't have a word for *exploded*. ". . . cracked open, much like an iceberg that floats into warm waters."

"There are waters, then, in the skies?"

"Uh . . . yes," Mike said. "Of sorts. The sky-points travel across the skies. The one that threatens the world cracked open as it traveled in its own path."

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"And so it threatens us, and the valley dwellers. What is to be done?"

"There may be a place for you to go."

Ahtenhurat gave Mike a direct, penetrating stare. "Where on the world would one go?"

"Not on the world. That is—not on *this* world."

Ahtenhurat tilted his head skeptically. "There can be no other world. Except that of the gods, if they exist."

"There are many worlds, Ahtenhurat. I have been to many of them."

"If there are such worlds, then, is there one on which my people and the valley dwellers can continue our lives?"

"My people know of no such world. There *are* worlds where you can live apart."

"*Apart?* Not possible."

"It must become possible, Ahtenhurat."

The highlander snorted. "Who else could provide us with weapons and tools? The lore of my tribe says once we didn't know of the valley dwellers. We didn't form encampments because we hunted and foraged constantly. Now we kill game as we wish, and we save for future days,"

"Surely you could learn the valley dwellers' lore."

Ahtenhurat picked up his furs and stood. "I've stayed here too long."

Mike rose. "I hope I've not offended you."

Ahtenhurat set a quick pace toward the western horizon. "Different peoples are suited for different skills. I could not find satisfaction in toiling over hot forges. My trading friend D'jirar would not be happy making furs. That is the nature of the world."

"Perhaps it is time I leave while we are still friends. I expect to see you again, though."

"I would like that, Makh," Ahtenhurat said. "To speak with you again will strengthen my hearts."

"And my single heart, as well." Mike muttered, "*Cosmic Egg*, retrieve." Then, to Ahtenhurat, he said, "I will greet D'jirar for you, when I see her."

Ahtenhurat asked, "So you will reach D'jirar before I do? How?"

"As the flamebird does. Look toward the western sky, Ahtenhurat."

The *Cosmic Egg* glided silently above the snowy landscape, arcing downward toward Mike and Ahtenhurat's position. Only at the last moment could Mike hear the whine of the shuttle's gravitics as they gently settled the craft onto the ice and rock.

Ahtenhurat stared slack-jawed. "If that is not a god-thing, Makh, I can trust none of my beliefs."

Mike told the highlander, "It's a thing my people have made—just as your people make furs. Just as the valley dwellers make knives and pottery."

Ahtenhurat stepped backward. "Its jaws are opening, Makh. Do not go into that thing."

"This is part of my people's heritage, to travel within such a thing."

"It'll deliver you to D'jirar with the speed of a bird?"

"Faster than the swiftest bird. You and D'jirar will have much to talk about." Mike entered the *Cosmic Egg*. The airlock doors slid shut behind him and he lifted off. Linna asked, from the *Asaph Hall*, "Are you sure that was wise, letting him see the shuttle?"

Mike said, "Whatever else I've accomplished, I've shown Ahtenhurat I'm not just a storyteller!"

D'jirar wrapped her furs more closely around her. Pausing only for a last wistful look across the Strait of Ancestors, she trudged southward toward the trading site.

The sun had barely begun to climb into the sky when D'jirar saw the god. It was silhouetted against the horizon, a tall figure whose form D'jirar could only perceive in broad strokes. It was tailless, stiffly erect as a highlander was, not comfortably leaning forward slightly as a valley dweller would be. As D'jirar drew

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closer, though, it became obvious this was no highlander. The god wore furs similar to D'jirar's own, and its face was neither furred nor scaled.

D'jirar stopped, suddenly frightened. She'd lost her sister, her males, her wares. What might this god take from her? When it finally spoke, D'jirar was almost overwhelmed with astonishment. "Greetings, D'jirar," it said. "My sympathies to you for your losses." The god's speech was rough and unmannered, lacking many of the smooth hissing sounds of valley dweller speech, but its words were plain.

D'jirar's tail swished nervously and her eyes blinked rapidly at the sight of this strange being. She said, "You speak as if you know me."

"You're the first valley dweller I have met. I wish to learn more of your people."

"Why would a god not know all there is about my people?"

"I am not a god," the being said. "But I know you just suffered the loss of your sister, L'hareni. And I know what that means to a valley dweller."

"You also know I have lost my trading goods."

"Yes, though I did not tell Ahtenhurat that when I spoke with him earlier today."

D'jirar's tail stiffened. "You spoke with Ahtenhurat—this very day, stranger?"

The being said, "I have a . . . tool . . . that brings me across long distances at great speed. My name is Mike."

D'jirar tried her best. "Ahhsss . . . ahhh . . . ghhh." She gave up. "I cannot say that."

"Do not worry, then, D'jirar. 'Stranger' it is. May I speak with you of important things—things I have already told Ahtenhurat?"

D'jirar's fears of this being faded now, replaced by wonderment and confusion. "You may walk with me," she said.

D'jirar and Mike walked onward across the plain. D'jirar squinted into the glare reflecting off the ice. She told of the responsibilities she accepted as trader. She told of L'hareni and how marvelous it was to grow up with a sister, and of the grief she felt now that L'hareni was gone, of the emptiness inside her. Mike listened patiently, and that was a comfort. "I thank you . . . stranger," she said, "for hearing my story."

Mike said, "Now I have a story to tell you about your people, and about the world." Mike proceeded to tell D'jirar an unlikely tale of how one of the lights in the sky—he called them "stars"—would someday turn evil and kill all life in the world. A place existed, he said, where the valley dwellers could go and be safe—as if there were somewhere else other than the world!—but the highlanders could not be with them.

When Mike had finished, D'jirar asked him, "Did Ahtenhurat believe this story?"

"In honesty, D'jirar, I think not."

"How can there even be other worlds? And if there were, how could there be worlds without the highlanders?"

"And if you were to live in a place without them?"

D'jirar's spirit was chilled more by this thought than the brutally cold climate here had ever managed. "My people would feel abandoned."

Mike said, "You *must* learn to live apart from the highlanders. Or you will all die."

D'jirar could not abide such thoughts. "Forgive me, stranger. The grief placed within me is too strong. Others must attend to these things, that could happen to those yet unborn."

"I cannot force you to decide upon a particular fate. I can only advise you as someone who has knowledge you don't. I'd like to meet with you again, and with Ahtenhurat."

D'jirar's thoughts were about to race out of control.

If her village and all valley dweller vil-

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lages were to be sundered from the highlanders . . .

Mike's story was seductive, and seemed as if it could be true. "Stranger," she said, "I must tell Ahtenhurat what happened, then return to my village."

Mike said, "Meet with Ahtenhurat. Then see if your lives take a different path."

"With respect, stranger, I will not speak of this unless Ahtenhurat asks me of it. I will only tell him of my failure . . . and ask forgiveness."

"I'm sure he'll understand," Mike said. "I'll see you again, and Ahtenhurat as well."

With those words, Mike looked into the sky. A large object which shone with the light of the hottest forge grew ever-larger as D'jirar watched. "Stranger," she asked, "tell me this is not the sss . . . ssstar you spoke of. It's not coming in my lifetime?"

"No," Mike said. "This is the tool I spoke of."

"This is something *made?*"

Despite his alienness, D'jirar thought she could feel the pride Mike felt as he looked upward at the thing. "Yes," he said. "It is called the egg."

Unconsciously, D'jirar moved back several steps as the thing hovered like a flamebird seeking prey, then lowered itself to the ground and became silent. Mike said, "Good luck, friend." He walked to the thing, which opened up and allowed him to walk into it. Then it flew away.

D'jirar watched the empty sky for some time. When she continued toward her meeting with Ahtenhurat, she had changed her mind about one thing.

She would speak with him about Mike, and about the egg, and whether death could really come from the sky.

As Ahtenhurat entered the steamy climate of the valley, he realized something was badly wrong. D'jirar looked weary. Dirt crusted the scales on her legs and arms. Her hands flexed nervously, and her claws were ragged and worn. And no pack beside her.

They made the ritual handclasp. Then came the moment when they looked into each others' eyes, as if trying to gauge one other's mood. Ahtenhurat said, "To see you, old friend, strengthens my hearts."

"My friend *Agh-en-hur-agh*. I must apologize. I have nothing to trade."

Ahtenhurat put down his own pack. "There must be a good reason."

"I left my village with four males, my sister L'hareni, and a sheath filled with pottery. All were lost in the Strait of Ancestors."

Ahtenhurat felt the oppressive heat of the valley smothering him. All thought of the wondrous things Mike had revealed was wiped away in an instant. Ahtenhurat knew what it meant for a valley dweller to lose a female relative. "I grieve as though I were of your tribe."

"I am shamed by my failure, Agh-en-hur-agh."

Ahtenhurat said, "The failure was not yours."

"I must also ask you about something that you may find difficult to believe," D'jirar said. "I met . . . someone . . . unlike anyone I've ever known."

Ahtenhurat said, "His name was—Makh!"

"Yesss," D'jirar hissed. "Did you believe his fantastic story of the end of the world?"

The extreme heat of the valley was melting ice crystals in Ahtenhurat's fur. He pushed back the brown hairs of his forehead that hung down in his eyes. "Nothing in my tribal lore prepares me for what he says."

"I fear most what he said about our two peoples."

"That they may not be able to live together, on our new worlds. Life must also have meaning."

The tone of this conversation made Ahtenhurat uncomfortable. He said, "If Makh is truly so powerful, can he not find a way for us to live on the same world?"

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"He has many powers neither of our peoples imagine. There could, however, be even larger powers, of the gods."

Ahtenhurat had never known whether the valley dwellers thought of the highlanders as gods or whether they simply believed the glacial lands of the world were where the gods lived. "I know little of the gods."

D'jirar said, "Then all those who died crossing the Strait of Ancestors died for nothing."

Ahtenhurat was horrified. "I never thought the valley dwellers seriously considered us to be godlike. I knew little of your religious beliefs, and I didn't want to offend you."

"Agh-en-hur-agh, my dear friend. I've become wiser about you, and you about me."

Ahtenhurat picked up his pack of furs. "Take these to your village."

D'jirar took them. "Remain well, Agh-en-hur-agh. I will not fail you again." She squatted into the position Ahtenhurat always saw her in first, and last, during these meetings.

"My hearts already gladden at the thought of seeing you again," Ahtenhurat said. He started the long walk out of the valley toward an uncertain future.

Two days after his return from Splendor, Mike met with Rosa and Linna in the ship's commons to tell them his proposal to save the Splendorians. Rosa asked, "So, what miracle plan do you have for us?"

Mike spread his hands out before him. "I believe we should spread the news of Splendor's coming destruction as we would the tenets of a religion—complete with missionaries. We'll help them develop cultural traditions supporting the idea of migration to new worlds. Those traditions will have to preserve themselves across a great land area and several generations of both species."

Rosa took a deep breath. She said, "Thousands of Unity personnel would have to devote themselves to this for years, perhaps decades."

"I suspect when the word gets out among the anthropologists and galactic species culturalists, we'll have to set up a waiting list."

Linna spoke up: "Keep in mind it's also an excellent way of studying the Splendorians' cultures. And our last opportunity to examine those cultures before they're permanently altered."

Mike added, "Not to prepare now would mean a logistical nightmare a century from now. Many would die in a forced evacuation. Or an armed conflict or another natural disaster could distract the Unity from this project, and drain resources from the rescue effort. Some of the social mechanisms we'd need are already in place. The valley dwellers have Gatherings that impart some of their rituals and other information between tribes. The highlanders have their Elders and Eldests who tell what they've learned during their lives."

Rosa asked, "But with so many thousands of separate tribes, each with their variations of highlander or valley dweller cultures, won't some reject the message?"

Mike intertwined his fingers. "We're here to give them choices, not determine their response. As long as we make sure the decision is an informed one, we have to be prepared to hear answers we don't want to."

Rosa nodded slowly. "Then it's decided. Mike, I assume the next step is another contact mission?"

"I thought we'd contact Ahtenhurat's tribe first. D'jirar's village is about to send representatives to a Gathering, and we should leave that ritual alone for now."

Rosa said, "Let's get to work, then."

Linna squeezed Mike's shoulders as they left the commons, then came around to walk beside him. "You know, you worry too much."

"I think I'm cautious."

"I'd call your plan daring."

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"I'd say it's methodical."

Linna shook her head in mock sadness as they turned down the corridor toward a grav tube. "Another illusion."

"So who tells you about your illusions?"

Linna's forehead furrowed as she stood at the edge of the grav tube. "I rely upon myself. And I'm often wrong. You want the job?"

"Damn," Mike said. "Something else to worry about while I'm saving entire planetary cultures from destruction. Mind if I come to your cabin awhile?"

"I'm sorry, Mike. I've been through this before. I can't turn off my empathy. I can't stop *feeling*. I've even had to keep my family at a distance. With lovers, I grow close, then I draw back. I know you're disappointed."

Mike dropped his hands to his sides. "Can't you also sense my determination to make this work? My affection for you? Don't they count for something?"

"Of course they do." Linna came to him and her lips brushed his cheek. "Just not enough." Then she disappeared down the grav tube.

D'jirar's people began the long climb that would take them to the top of the ice cliff where they and five other valley dweller tribes held their Gathering. The smooth, flat ice they'd been traversing gave way to rough and rocky hills. They were the eroded debris deposited by a glacier that had slid down from the mountains to the north. Just to the east and north of the glacier's path was the plateau where the Gathering would take place.

D'jirar needed to confide in someone. Once atop the plateau, she sought out N'lorabok, who was from a village far to the north, and known for her many radical views about the gods. She was a tall female with well-defined scales a brighter green than any D'jirar had seen.

D'jirar asked N'lorabok to come speak alone for a few moments. "Gladly," she said. They found an unoccupied shelter, little more than a windbreak, and sat. N'lorabok said, "I must tell you of the sadness L'hareni's death placed within me."

"Thank you."

"D'jirar, I've been told that you had a most unusual experience that leads you to new ideas about the gods."

"You are sure there are gods to have ideas about?"

"Be careful, my friend. We cannot pretend to know those who created the world. Whatever they are, they are unknowable by such humble beings as we."

"What if I tell you the gods' reasons for being may not involve valley dwellers at all, or highlanders? What if I tell you the gods might wish to destroy the world?" D'jirar told N'lorabok of Mike and his prophecy of the end of the world. N'lorabok listened intently, then uttered a skeptical hiss. "Forgive me, D'jirar, but talk of the end of this world is dangerous enough. The greater risk could be to speak of new worlds. You have startled me and made me dream of things no valley dweller has ever thought of before." N'lorabok looked deeply into D'jirar's eyes. "I cannot see your intentions."

D'jirar said, "I begin to see what I must do."

It was difficult for D'jirar to remain behind the next day as the Gathering broke apart. The pilgrims from N'lorabok's village were the first to leave. N'lorabok herself told D'jirar, "Find that which you seek," she said. "And live to tell the rest of us of it."

"Thank you, old friend."

Soon D'jirar stood alone atop the plateau. She must find her own path away from these ice cliffs where she would be too exposed against a coming storm. By the time the sun hovered above the western horizon, D'jirar saw a place about a quarter of the way down where she could make her way across rough ground to the east, then swing north toward the lands where the gods might live.

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D'jirar did not intend to be a martyr. I will journey until just over half my provisions are done, she thought. Then I will turn back.

Darkness arrived, the winds blew stronger, and snow fell. D'jirar found refuge, a sharp rocky overhang just the proper size to squeeze into. She listened to the storm's fury and watched the snow pile up before her. After a time, she curled up, pulled her furs as closely around her as she could, and slept.

D'jirar awoke in utter darkness, and encased in a cocoon of relative warmth. It was as she had hoped; the snow had buried her within the small crawlspace. She bared her sharp claws and emerged into a bright clear day, the storm having purged the sky of clouds.

She decided to swing north and journey toward the seemingly endless mountain range where so many valley dwellers had fared over the years, searching for the gods.

Mike stayed away from Linna for two days, and when he showed up at her cabin on the third day, she grinned at the sight of him, pulled him into her cramped quarters and onto her bed, and they made love most of the afternoon. Their work on Splendor went straight to hell that day, but who cared?

It happened early one morning in Ahtenhurat's encampment. A youngster woke him, saying her mother needed to speak with him. Ahtenhurat rose slowly. "What does your mother require?"

The child said, "She needs to talk to you. About Eluhar . . . uhar . . ."

"Eluharobak?"

"Yes."

"Take me," he told the child, and followed her toward the edge of their encampment. Was this child's mother living out here on the perimeter?

The child led him into a darkened area behind a sharp outcropping of rock that hid them from the settlement behind. Too late, Ahtenhurat became suspicious.

A shadowy figure appeared, knife raised. The blade plunged into Ahtenhurat's chest. He fell forward, and when he struck the ground, the knife dug deeper into his body. He couldn't raise his face. Every attempt to inhale drew ice and dirt into his mouth. He choked.

Ahtenhurat heard footsteps padding away. He felt his blood's warmth streaming from him. He wondered when the pain would begin.

A touch at his shoulder. He jerked away, until he heard the voice. It was the child. "Get up. Please. Don't be hurt."

Ahtenhurat strained to speak, his mouth still pressed against the ground. "Listen carefully, little one. Do you . . . know Indirogar?"

"Yes."

"Find . . . find him." He didn't know if he'd actually spoken those last words to the child, or if she was still there to hear them. Then all awareness faded.

He awoke in agony. Groaning, eyes closed tight against the pain, he tried to roll over, to flee the hurt. He could not. He tried to clutch his chest, but someone grasped his hands and forced them down. Indirogar said, "Please, Elder, don't try to move again."

Ahtenhurat rested in his shelter, his body covered with quicksleep furs. He smelled the harsh, slightly spicy scent of healing herbs. Indirogar, to his left, knelt beside him. "You were betrayed, Elder," Indirogar said. "She stabbed you in the stronger heart. Uroharasek was her name. A distant cousin of Eluharobak."

"I should have realized my danger. What has happened to the one who attacked me?"

Indirogar said, "I killed her with my own spear."

Ahtenhurat tried to lift his left hand, then groaned as a new surge of pain swept through him. The hand fell back to his side. "What of the child?"

"She was blameless. Her father died during the hunt last year. We'll place her with another family."

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Ahtenhurat said, "I wish I could see Makh again. Perhaps he could find a solution to this conflict within our tribe. But I do not know how to find him."

Ahtenhurat was dozing when the commotion began. He squinted against the glare of the midday sun lancing into his shelter's open flap. He tried to turn toward the shouts and confusion, but a sharp pain in his chest struck him in full agonizing force.

Recognition came as the crowd halted before his shelter, then parted to make way. Makh! And—another of his kind, this one a bit smaller, but with a little more of that skimpy thatch of hair on his head. Neither was clothed in the furs Makh had worn during their previous meeting. Instead, they both wore odd, thin garments that fit much closer to their bodies.

Indirogar looked at Ahtenhurat as if uncertain whether to believe his eyes. "Is this truly Makh?"

"Let him approach, and his companion, as well."

Indirogar lowered his spear. Makh and his companion entered the shelter and knelt next to Ahtenhurat. "I didn't expect to greet you again so soon," Makh said. "I hope I haven't upset your people."

"You've told them more merely by your presence than was believed when I spoke to them. You—and your companion."

Makh said, "This is Linn-na. She assists me in everything regarding my people's relations with the highlanders and the valley dwellers."

"She?" Ahtenhurat mused. "So this is a female of your people. You are full of wonders. Where then, is your—flying-thing?"

"We left it outside your encampment. I was afraid it might disturb your people. Tell me about Eluharobak—do you trust him to tell the truth, even though he may have asked his followers to kill you?"

"A highlander could bring violence yet still be honorable enough to speak the truth when asked. Eluharobak's a fine hunter. He was once a tribemate I respected and honored. Now, I fear he lies to me—and that is more rare among us than violence. The body heals. It is much more difficult to purify the spirit."

Makh said, "You've been impressed by some of the tools my people make, and some of our powers. Linna has a power I do not possess, one quite rare even among my people. She can perceive anyone's true feelings."

"You mean—one cannot lie to her? Even someone who is not of her people?"

"You may lie, but she will know it. And it is more difficult for her to perceive a highlander's feelings and intent, but she can do it. Now, I must have a chance to speak with your tribemates. Especially Eluharobak."

"Very well. Indirogar!"

Ahtenhurat's tribemate stuck his head into the shelter. "Yes, Elder?"

"Find Eluharobak. Bring him to us."

Indirogar said, "He's here, Elder. Perhaps he will tell us now of his treachery."

From behind Indirogar, out of sight, Eluharobak's voice: "That is a lie."

Eluharobak stepped around in front of Ahtenhurat's shelter. His long brown fur was as matted and tangled as usual, and had never looked uglier. Indirogar grasped one of Eluharobak's arms. "Not so close," he said.

Eluharobak regarded Makh and Linn-na warily through the flap of the shelter. "So, Ahtenhurat. You told the truth about this strange one. And now the star-point we cannot see will end all we know? You must tell better tales than that, no matter what your powers."

Ahtenhurat said, "You're not one to speak of telling truthful tales."

"This stabbing was not my doing. If your attacker had been allowed to live," Eluharobak said, glaring at Indirogar, "I'd have banned her from my group."

"More lies," Indirogar said.

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Linn-na spoke up. "Elder—may I speak?"

"Quite unusual," Ahtenhurat said. "Eluharobak, do you object?"

"It is not quite proper. However, the words of a female cannot harm me."

Linn-na said, "Eluharobak is telling the truth when he says he did not order—what was her name?"

"Uroharasek," Indirogar prompted.

"He did not order her to attack you."

Ahtenhurat's spirit was now as injured as his body; why would Linn-na tell him his enemy was truthful? Did she and Makh intend to align themselves with Eluharobak now that he was near death?

Or could both Eluharobak and Linn-na be truthful? Highlanders valued truth, but Ahtenhurat knew it rarely aligned itself with the wishes of those who sought it. "Linn-na . . . Makh . . . you tell me things I would prefer not to believe."

Makh said, "If Linna tells you Eluharobak is telling the truth, then he is."

Eluharobak regarded both Makh and Linn-na, then said, "The most important matter before us, Elder, is that you're unfit to be tribal elder. You must step aside."

"No!" Ahtenhurat declared. "Only death will remove me as Elder."

"Already we have remained without an Eldest much longer than our tribe ever has. Now you propose that upon your death, you leave us without an Elder as well."

"You're not concerned with our traditions. You care only about your own wishes to gain power."

"Elder, if you step down now and become Eldest, you'll be treated with honor the rest of your days. There are those who agree that you should step down, but believe I move too slowly. I cannot control all of them."

"He's still telling the truth," Linn-na said.

Ahtenhurat said, "Please be silent now, Linn-na, and Makh." To Eluharobak, he said, "Know that when the next attempt comes, my own followers will be ready."

Eluharobak straightened his muscular form. "Time will give me what I desire." He left.

Ahtenhurat said, "I will die soon. The tribe must continue, despite our current troubles."

Makh asked, "And if Eluharobak stands in the way?"

"More violence. Can you help us, Makh?"

"We didn't come here to become involved in your tribal disputes."

"Perhaps they seem like the arguments of small children. But we cannot concern ourselves with our children's children's children. We must care for our children today."

Makh said, "Today's work is never finished. You'll never see a time to look toward the many tomorrows ahead."

Ahtenhurat shifted his old bones again, with a little less pain this time. "Makh, I am honored to find questions you cannot answer. If we cannot change ourselves before the sky-point destroys us, we will be unworthy to survive."

Another new expression now, on both Makh and Linn-na's faces, a downturning of the corners of their too-naked mouths. Ahtenhurat believed he knew its meaning.

Just before dusk, D'jirar skirted a giant sinkhole, half as wide as her entire village. Peering into it, she could see layer upon layer of ice within, edging into darkness.

D'jirar drew closer, curious as to how deep the sinkhole was, and whether her hunch about how it formed was correct. She laid her pack on the ground and crawled to the edge. Warm air struck her face—just as she thought! The life-giving heat that gave the valley dwellers life had also formed this hole.

Her eyes could just make out the steaming water flowing through a chamber below. The air's warmth was soothing. How marvelous it would be, she

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thought, to find a way down there and splash around like a playful child, or an uncaring male.

She eased back from the opening. She'd taken barely sixteen steps when the snow began to give from under her feet. A hidden crevasse!

The world leaped upward to envelop her. Instinctively covering her head, she took a blow to her left arm, which resounded with a muted *crack!*

No time to react to that agony—still falling, no footing, rolling over and over. The walls surrounding her fell away, warmth enclosed her, and she fell free, for a long, terrifying moment.

A wall of heated water struck her, almost searing in the intensity of its heat. She struggled to orient herself. Her furs were dragging her deeper. Laboriously, her lungs about to burst, she worked the furs off, pain piercing anew through her broken arm. She pushed upward, her left arm helpless at her side.

D'jirar broke the surface, flailing wildly with her good arm. Steam filled her nostrils. The water was almost scalding. Something struck the backward-jutting part of her skull. She was being swept away by a strong current in an underground stream.

The way ahead brightened with the familiar crimson glow of the setting sun. D'jirar knew this had to be the very same stream she'd examined from the safety of the top of the sinkhole moments earlier.

The stream curved abruptly to the right as it flowed through the sinkhole. If she could draw closer to the side of the chamber—D'jirar kicked her legs and paddled as hard as she could with her right arm. Beyond, the stream disappeared underground, beneath an outcropping of rock. She *must* make it.

On the outside of the curve, water crashed violently in a continuous spray against the wall of the chamber. If she were caught up in that—

D'jirar's claws scraped rock, slipped off. She reached out again, grasped stone, held fast. It was all she could do to keep from being swept away. Muscles straining with their last strength, she pulled herself from the water and collapsed onto the rocky ground.

She lay there, not knowing how to reach the surface, fearing she had no hope of rescue or even of anyone finding her bones.

Mike and Linna settled into one of the crude, shallow shelters in Ahtenhurat's encampment. They would stay the night here. Soon Mike held Linna close. Her eyes were hooded. She said, "We have to enjoy this while we can. . . ."

She didn't finish, didn't need to. Mike knew she'd have to break away to be alone the moment they arrived back on the *Hall*. He said, "You can tell I want to be with you more than I am. But I'll accept as much, or as little, as you can give."

Linna nestled close. "Don't ever think I want it any less."

"I'd never think that."

She kissed him. "Morning really does arrive too early. Eighteen-hour day." Linna rolled from him and was soon asleep.

Mike was barely dozing when his datalink brought him alert. "Mike, Linna—This is Rosa."

Mike raised himself on one elbow, saw that Linna was awake, too. "Go."

"Disturbing sensor readings from D'jirar's location just a few minutes ago," the *Asaph Hall* captain said. "She's fallen down a crevasse. She's got a broken left arm. Some internal organs damaged or even ruptured. Loss of blood. She's unconscious."

Mike stepped out of the shelter. "I'm calling the *Egg* to us."

Linna touched Mike's arm. "You rescue D'jirar. I'll stay here with Ahtenhurat."

The ovoid form of the *Cosmic Egg* glided into view. Mike heard the gasps of surprised highlanders as they marveled at this magical device that had appeared so suddenly in the night sky. Several

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grabbed spears and started toward Mike and Linna's position.

Mike watched the hunters advance. Linna pushed him along. "I'll be fine."

The *Egg* descended toward Mike, its outer lock opening as its skids cracked through a thin sheath of ice over the snowy ground. Within moments Ahtenhurat's encampment was kilometers behind. He spoke to Linna, "What are our friends doing?"

"They're more in awe than anything else."

"Keep me posted."

The *Cosmic Egg*'s gravitics hurled the shuttle through the Splendorian night, crossing the 250-kilometer distance from Ahtenhurat's encampment to D'jirar's position, leaving a trail of sonic booms and lightninglike flashes of minor space-time disruptions in its wake. Within three minutes, the *Egg* hovered over a large sinkhole in the middle of a frozen plain.

Rosa's voice came over Mike's datalink. "D'jirar is lying on a patch of ground to one side of an underground river. It should be accessible through the sinkhole."

Mike arced the *Egg* around the hole. He estimated it at a hundred-twenty meters across. "How could an experienced traveler like her miss a hole like that!"

"She stepped into a nearby crevasse covered up by recent snowfall, and fell into a chamber adjacent to the sinkhole."

Mike said, "I've got to take the *Egg* into that sinkhole." A continual updraft of warm air created minor turbulence, but nothing the *Egg*'s computer couldn't compensate for. He had plenty of room on all sides, but was still uneasy taking a spacecraft underground. As he descended, he gazed out at layer upon layer of ice, a frozen record of thousands of years of snowfall.

The sinkhole was about 230 meters deep. Mike halted the shuttle's descent ten meters from the surface of the raging underground river. There—he could see D'jirar's image. She must have barely made it onto a tiny patch of land. She could still die of exposure within moments.

Mike pressed a control, and an enticement field radiated outward, its reddish glare illuminating the ice chamber's interior. D'jirar's rigid body lifted from the ice and rock and glided smoothly toward the shuttle. A containment lock on the *Egg*'s right side slid open, receiving D'jirar's still form.

"I have her," Mike reported to the *Asaph Hall*.

Mike lifted the shuttle out of the sinkhole and within minutes was landing just beyond Ahtenhurat's encampment. Mike put the *Egg*'s systems on standby, ready to lift off quickly if he needed to. "I'm back, Linna. I know you can't say much. Just gimme a sign you're okay."

Over Mike's datalink: "Uh-huh."

"I'll update you on D'jirar as soon as I know something." Mike went back to the containment lock. D'jirar was lying there immobile within the soft blue glow of the stasis field. Her eyes were closed and her wide face seemed peaceful. He wouldn't let her awaken until he mended her.

"Medcomp access," Mike said to the shuttle's computer. The valley dweller's vital signs confirmed she was in critical condition. "Analyze patient's biochemistry and design nanites with priorities of healing damaged organs and reducing trauma and shock. Secondary task, setting the broken arm."

An answering tone told Mike the computer had gone about its silent, microscopic task. Linna's voice came through the datalink: "I'm with Ahtenhurat again. He wanted to speak with me after he heard the excitement your departure caused."

"Tell him he and D'jirar have to meet soon. She should be recovered sufficiently in a couple of hours."

"I'll let him know."

Mike pondered that Ahtenhurat had such strength of will, and D'jirar such

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determination, that if anyone ended up deserving the credit for bringing this project off, it would be them.

Ahtenhurat was glad his hunters had calmed down following Makh's sensational departure. Linn-na explained that Makh had left to save an injured D'jirar. She sat next to him now, seemingly untouched by the wind or cold.

Then Linn-na told him D'jirar was safe, though only moments had passed since Makh had left. D'jirar had been many dozens of days walking from here!

Linn-na touched a small cylindrical object to his left arm. The agony of his wounds flowed away. "I've not treated your injuries," she said, "just rid you of the pain."

Ahtenhurat thought, I have so little time left! He told Linna, "Help me save my people from Eluharobak. Allow me to live long enough that I might help my people onto the path toward the skypoints."

D'jirar awoke in a narrow chamber in which a mysterious blue glow emanated from all sides. She rested on a hard smooth surface that was neither rock nor snow. Have I joined the gods, she wondered. The last thing she remembered was her frightening plunge into the sinkhole and her desperate attempt to survive. Then, to D'jirar's left, the glowing blue wall slid downward, revealing Mike.

"I have succeeded!" D'jirar exclaimed as Mike helped her out of the chamber into a hut or cave she could never have described. D'jirar's tail wrapped itself around her left leg, an embarrassing reaction, that of a frightened child. "I wished to find the gods, or find you."

"I didn't appear because you wished it, D'jirar."

"Where are we?"

"Aboard the egg," he said.

The fear she'd left behind in the chamber rushed back. "The same thing that swallowed you up?"

Mike's mouth widened in a now-familiar expression. "I lifted you out of that sinkhole, and healed you. We are just outside Ahtenhurat's encampment."

"So far, in a single day?"

"Within moments, in fact. I have a companion named Linna, and she's with Ahtenhurat. Has he mentioned the tribal conflicts he's been trying to resolve?"

D'jirar felt Mike's eyes on her as she leaned into a three-point stance of two legs and tail. "Have they grown worse?"

"Ahtenhurat was attacked, and . . . will probably die."

D'jirar closed her eyes, a brief retreat into thought. When she opened them again, she said, "I told you I sought the place where other valley dwellers fared."

"Searching for the home of the gods."

"Yet you maintain you're not a god. Only a . . . person, like me."

"Yes, only a person," Mike said. "In fact, some of my own people would deny me even that status."

"Why is that, Mike?"

"That's not important now, D'jirar. Convincing you I'm telling the truth is."

"Then show me what happened to those explorers. They found something that kept them from returning."

"Perhaps . . . death."

"I never expected the gods to reveal themselves. But I'm asking for something you *can* show me."

Mike turned away from her. Why did he hesitate? Then he turned back toward her. "I'll try to find them."

D'jirar watched as Mike spoke to an unseen presence. Then Mike's head, with that unlikely shock of dark brown hair, tilted as a quicksleep's might as it listened for the rhythmic sound of a burrower beneath snow. He said, "You'll have to fly with me in the egg as it travels to our destination. Are you no longer afraid of it?"

If she were completely truthful, she'd tell him how deathly afraid she was. Instead, she said only, "We should go."

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Mike lifted the *Cosmic Egg* back toward the northeast, toward the mountains D'jirar sought before she was injured. Pinpoint's reflection against the icy landscape paced them, its motion as smooth or irregular as the regions beneath it.

Mike asked Rosa aboard the *Asaph Hall*, "Any luck?"

"Head for these coordinates." The bearing appeared on the *Egg*'s nav readout.

The mountain range fell behind them and they soared over an ice plateau. The site Rosa found for him was two hundred kilometers past the area where Mike had found D'jirar. "You'd never have made it this far," he told her. "This must be much farther than any valley dweller has ever journeyed into highlander territory. They'd have come here about—" Mike calculated the difference between Earth years and Splendorian years. "—five years ago."

"I knew valley dwellers who made such an attempt then."

Mike set the *Egg* down on a featureless plain and set the shuttle's systems on standby. He told D'jirar, "This is where they died."

D'jirar looked out the front viewscreen, then back at Mike. "I see nothing here."

"Let's go out there," Mike said. He rose from the pilot's seat, grabbing his sensorpac as he went, and took a stunner from the weapons compartment. They entered the *Egg*'s inner airlock. D'jirar watched him curiously as he closed the inner hatch and opened the outer one, activating his lifesuit at the same time.

Windblown snow swirled before them. D'jirar bunched her furs around her neck. Mike felt only the pressure of the wind, not the cold. He motioned for D'jirar to precede him outside.

They stood on a stark plain beneath an azure sky. "See that small rise just in front of us?" Mike asked the valley dweller. A barely visible mound of snow rose there, not more than knee-high to Mike and about fifteen meters across.

"Yes," D'jirar said.

Mike pulled the stunner from his belt, set it on high and aimed at the perimeter of the mound. "Don't be afraid of the noise and light from this tool," he told D'jirar.

He fired. Ice shards flew, steam rose, water flowed.

As five years' accumulation of ice melted away, Mike revealed a tableau of horror. Mummified bodies were stacked upon one other three and four deep and as many across, in a semicircular pattern. Three more bodies were lying huddled within the semicircle. Patches of skin stretched tight over skeletal remains. Empty eye sockets and exposed bones were signs that the bodies had been scavenged before successive snowfalls covered them.

D'jirar stood perfectly still, her tail wrapped around her left ankle, as if fearing to disturb the scene before her. "Why are the bodies piled together so?"

"The three individual bodies are to the southeast of those stacked up. A storm would probably have come in from the north or west."

D'jirar stepped back in terror. "They . . . used the bodies of those who died before them—as a storm break?"

"Don't judge them harshly. They were trying to survive."

D'jirar said no more, only gazed upon the remains giving silent witness to the frightful events of five years past. Mike could only wonder what thoughts proceeded behind those amber eyes.

D'jirar faced him. "I am yours now. We must save my people, and Ahtenhurat's, and their futures."

Mike led D'jirar back into the *Egg*. Gravitics whined and snow swirled as he lifted the shuttle back toward Ahtenhurat's encampment. Mike had hoped to get these two leaders together in a few weeks or months, to work out a plan to educate other Splendorian tribes. Those

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hopes were now dust, and he'd have to improvise.

Ahtenhurat motioned Linn-na closer. "Is Makh coming?" His voice was weak and thin and carried the certainty of dying.

"He'll be here soon, with D'jirar."

"Tell Indirogar . . . to summon Eluharobak again."

"I'll tell him," Linn-na said, and left.

Soon the entire population of the encampment gathered around the entrance to his shelter. Linn-na returned to his side. "Help me sit up just outside," he told her. "I'll not lie flat to say my final words before my tribemates." Linn-na did so. He saw Indirogar and Eluharobak at the front of the crowd.

But before Ahtenhurat could speak, the crowd parted and Makh led D'jirar into their midst. The valley dweller looked much healthier than at their last meeting. Her skin was a deeper green, her loping stride more resolute. She knelt before Ahtenhurat and took both his hands in hers. "I'm glad to see you are well, *Agh-en-hur-agh*."

"Your presence strengthens the one heart that has not yet betrayed me. But first, Eluharobak—Indirogar—stand before me." They stepped out from the crowd. "I accept the post of Eldest." The murmur of approval from those around him was immediate and gratifying. Ahtenhurat suspected many were less interested in who succeeded him than in ending conflict and maintaining tradition. "Now I decide who is to be Elder. I must keep the welfare of all my tribemates in mind. I choose Eluharobak."

For several moments Ahtenhurat was aware only of the commotion his announcement caused: the gasps at the mention of Eluharobak's name, the dismayed look on Indirogar's face, and the rhythmic thumping of Eluharobak's supporters striking their spears against the ground in celebration. He let the various displays of joy and disappointment go on for a brief time, then, laboriously, held up his hand for silence. All quieted.

Ahtenhurat caught Eluharobak's eye. He knew his rival understood what had really happened. Eluharobak gestured angrily toward Indirogar. "You were to have picked *him!*"

Ahtenhurat said, "I shall die soon, and you wished Indirogar to quickly become Eldest, so you could ignore his counsel. Now it is you who will become Eldest soon. As you insisted I should when our previous Eldest died."

"Things were different then."

"I wish Indirogar to be Elder when you rise to Eldest. How will it feel for him to resist you as you have resisted me all this time?"

"You cannot name Indirogar to succeed me."

"Many among our tribemates still respect my views. Try to lead without his support and cooperation. You'll find it as difficult as I did without your support."

Ahtenhurat felt his strength ebbing. He must speak quickly. "As Eldest, I give you your first advice. Go with Makh and Linn-na, in their flying tool, and see the world from the skies. Listen to them, and you will know of a responsibility far beyond this tribe."

Eluharobak made an overly dramatic effort to refrain from baring his teeth. Indirogar stepped forward and said, "I'll travel with Makh and Linn-na, if I must. I do this out of respect and love for our Eldest, Ahtenhurat. And Eluharobak should travel with us."

Eluharobak stood stiffly, unyielding, but said, "I will go with them to judge the truth of what they say."

The tension flowed out of Ahtenhurat. My work is over, he thought. He looked toward the heavens, where the sky-points hid behind the blue shield of day. To have seen other worlds!

He closed his eyes. The voices around him faded, and soon consciousness dimmed. He wondered whether he

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would awaken with his people or travel into the realm of gods.

Mike stood over Linna as she looked up from the still form on the icy ground and said in the highlander tongue, "Ahtenhurat is dead." The dead Eldest's tribemates wailed their grief. Mike hadn't that luxury. He didn't want to wind up grieving for the entire highlander species, and the valley dwellers as well. Time to improvise on his improvisation. "D'jirar—Eluharobak—Indirogar—" The three Splendorians turned their attention to him. "We have much to do."

Once again D'jirar rose into the skies, encased within this made-thing called the egg. She marveled at its speed, as it burst through the clouds.

She sat in front, tail curled in her lap this time. Mike was in the rear with Indirogar and Eluharobak, and it was Linna who kept watch over the egg as a female might supervise her males.

The skies grew dark much more rapidly than a normal nightfall. She asked Linna, "Have we come beyond the sun?"

Linna replied that all was night beyond the world, and that the sun shone within that darkness only as the brightest and closest of the stars.

Indirogar asked if the vast blue and white object whose curve they could just begin to perceive was the world. Mike said it was.

"All the world," D'jirar said. "Valley dweller and highlander alike." She could never have imagined such beauty. Directly below stretched a broad snowy peninsula that spread wide fingers across a deep expanse of ocean. The landscape was as wrinkled as the loose skin of a burrower's thigh, and she could not understand why that would be. Then she realized—she was seeing mountains from above, far above! Well back from the shore, smoke rose over a smaller area of land that glowed red at several points. That, D'jirar realized, is where my own people live, and it is so small.

Even here outside the world, D'jirar realized, I am a part of it. Give me the stars, yet my gaze still returns homeward.

Mike wished he possessed Linna's insight as he watched D'jirar's reactions. Her liquid eyes stared unblinking and the tip of her tail twitched repeatedly, as if her accumulated tension bled off from it. She, Indirogar, and Eluharobak—all jumping ahead centuries, even millennia in their knowledge of the universe.

Eluharobak said, "Down there is all we know. All who have lived. All our traditions."

That was exactly the reaction Mike hoped for. If these beings, highlander and valley dweller alike, could see their world as a whole, and not just as their individual tribes . . .

Mike said, "It's time to create new traditions. You must learn each others' skills and pass them to new generations. Each must learn to live without the other."

Eluharobak said, "You are taking us down Ahtenhurat's path. You wish too much change for the highlanders."

D'jirar said, "I share that fear. I don't wish my great-grandchildren to live in a world without highlanders."

Mike leaned forward. "You and those who live after you will prepare them. They'll be ready, and the new worlds will seem as natural to them as your world does now."

Linna said, "Consider all that's changed for you already. You once thought the highlanders might be gods. You now know Ahtenhurat was no god. Yet is he any less worthy of honor or respect?"

D'jirar's tail twitched, and her eyes closed for a second, then opened. "You say the truth, Linna."

Eluharobak pointed a brown-pelted finger at Mike and said, "I'm a highlander. Do you know what that means?"

"Tell me."

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"We hunt the quicksleep. We trade with the valley dwellers. That is our life. You promise us a new home on another world. We wish to keep the life we have on our world, the world you call Splendhor."

"Even if it means your way of life dies?"

Indirogar said, "I've stood against Eluharobak in the past. Now I cannot. Though I honor Ahtenhurat's memory, he wished to take us from those things that make us highlanders. Our people would sacrifice much to preserve our way of life, but I do not see this as preserving it."

Mike realized that if Indirogar couldn't embrace this, they'd lost the highlanders. He was counting on him to convince the others to carry on Ahtenhurat's work.

D'jirar grasped the tip of her tail. "Our lives are not just one event after another, to be followed by our individual deaths. Our lives must have meaning."

Mike said, "We're not saying you need to abandon your beliefs, your faiths . . ."

Eluharobak clenched his fists and Mike had a sudden frightful image of the highlander wishing he held a spear. "We wish to keep our lives as we have found them worth living—highlanders living among valley dwellers, on our own world. Return us to our world—*now*. We'll speak no more of this."

"Please," Mike said. "We're so close—"

Indirogar said, "I will not know how to tell my children that their children cannot live in the world their ancestors have known."

Home. Mike understood that yearning as well as anyone here. He'd only been trying to defeat the fear. He had to give them the joy. He asked, "What if your descendants didn't have to give up your way of life forever? What if highlanders and valley dwellers could live together again?"

Indirogar said, "You told us no other worlds where we could live together exist."

"But there will be one—Splendor. It won't be easy. Most life there will die. We'll have to take samples of Splendorian plants and animals and make records of their genetic makeup, so we can reintroduce them. Some life-forms will survive, but they'll change their nature permanently. An animal like a quicksleep might be smaller and eat different foods. Any plant you eat safely now might be poisonous then."

D'jirar asked, "Are you promising the impossible?"

"I hope not. We thought once you settled on new planets, you'd establish new ways. Would your people have the determination and courage to retain their customs on a new world, generation after generation?"

"Knowing that they would one day return to Splendor? They could do so. Do you agree, Indirogar?"

The first time he's spoken directly to Indirogar, Mike realized. A good sign.

"I agree," Indirogar said.

And D'jirar said, "I believe we could be as determined and patient as highlanders."

Eluharobak slapped Mike so hard on the shoulder he feared going right through the bulkhead. "I congratulate you. You save two peoples and give me a reason not to kill Indirogar."

The two highlanders laughed, and D'jirar hissed, which Mike supposed was the same thing, but he hesitated joining in until Linna said, in English so the Splendorians wouldn't understand, "It's all right. They'll work together now." Then he let himself guffaw until his sides hurt.

Things happened quickly for D'jirar.

Mike suggested that, even though the coming fury of the star was many sixteens of years away, that they should begin to spread the word to other tribes. Eluharobak made his first recommendation as Eldest, and volunteered to go along. Indirogar made his first decision as Elder in allowing it. The egg flew

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down from its vantage point above the world and dropped Indirogar off at his tribe's encampment.

Then Linna instructed the egg to fly toward a highlander encampment nearly an eight of days distant. Mike told her and Eluharobak, "Remember, you must find those who will help you spread the word. Several generations may not be long enough to convince every highlander and every valley dweller of what you've seen, and that the danger is real."

Linna said, "Mike and I must leave Splendor now. We ask you to trust them as you have trusted us."

Eluharobak said, "If they are worthy of as much trust, we will honor them."

Mike said, "That's all we can ask."

Soon the egg landed softly just outside the highlander village. D'jirar's body virtually tingled with wonder at the distances they'd traveled so quickly. She must ask Mike one question now, because she might never see him again. Over the dying whine of the egg, she asked, "Why did the people on your own world not accept you?"

Mike seemed unable to find words.

D'jirar pressed on. "I was only curious as to why your people would not accept someone of your courage and skill. If I have offended you—"

"I would not wish you to think less of me, as some of my own people do."

Eluharobak said, "Makh, you have won my respect honestly, and that of D'jirar, as well."

"Very well, then. You know my people have talents to make things such as the *Egg*. What I have not told you is that *I* am also a 'made thing.'"

D'jirar did not understand. "Are you saying . . . you are not real? You are yourself a tool?"

"I am as much a person as you. But my people can craft flesh as you do stone or metal."

The tip of D'jirar's tail curled around her right leg. "I still see you as the person I believed you to be."

"Not everyone on my home world felt as you do."

"But you did not let those others defeat your spirit."

"No," Mike said. "I didn't."

Outside, the egg's arrival had caused quite a commotion, as highlander hunters grabbed their spears and formed a line between the flying tool and their encampment. "We should go," Eluharobak said. "Luck to you, Makh. Your courage strengthens my hearts."

Moments later, D'jirar stood with Eluharobak just outside the egg. Mike and Linna watched from its entrance. The highlanders, noisy and still brandishing their spears, stared with naked curiosity at these familiar beings who had come from this tool that must, D'jirar realized, seem godlike to them. She considered how odd it was that a tool that had seemed so magical just days ago was now comfortable and familiar.

"Do not worry," Eluharobak said. "I've hunted with their Elder. They will know me."

D'jirar said, "Then we should go." She and Eluharobak said their final goodbyes to Mike and started across the snowy landscape toward the encampment.

The highlanders recognized Eluharobak, and lowered their spears. Several pointed at the egg as it rose into the heavens, where it soon became a dwindling dot.

I'll make myself worthy of Mike and Linna, she thought. I'll work to help both our peoples survive our world's death, so we may see its resurrection.

Four days later . . .

Mike and Linna floated, nude, within a small spherical room, set to zero-g. It was warm and filled with musky human-smell, the aftermath of lovemaking. They bounced gently off the padded interior of the room wherever they thumped against it.

Mike and Linna had chosen about a quarter of their surroundings to be a

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real-time picture of Splendor. Soft, milk-colored clouds scuttled over ice fields and blue-green seas.

Mike said, "The *Erasmus* arrives in a week. They'll take over once we introduce their main contact team to D'jirar and Eluharobak."

Linna ran her hands through Mike's curls. "It's been a long time since I let someone get this close." Mike started to speak, but Linna clapped her hand over his mouth. "Don't say it. It's redundant to an empath. I like just ***knowing***. I don't need to hear it."

"I've wanted to be close to you so badly since we got back."

Linna said, "We still can't be together all the time."

"To hell with 'all the time.' Right now, and whatever series of 'right nows' we can have, are enough."

"So you can love from a distance?"

"Ah! You used the word."

Linna said, "I didn't say I never used it. Just that it was redundant to launch it in my direction. You're not answering the question."

"I can love from a distance. Or for a moment, if that's all we have. Look at the danger facing Splendor. It all happens in an eyeblink, from a galactic viewpoint."

"That makes an entire Human lifetime *less* than an eyeblink. Not very significant."

"As significant as you want it to be. What matters is what you're doing *during* the eyeblink."

"I think most of the beings on Splendor a century from now will survive. Thanks to us."

Mike kissed Linna's neck again. "And what about us? Will what we have survive?"

"It will for now. That's all we can do."

"Just make sure 'now' doesn't end?"

Linna grinned. "Just don't blink. You know, we're wanderers. Rootless. But I can feel the pride you have every time you come back on board. I bet you've seldom felt that way about anywhere you've lived before."

"I hadn't realized it, but yes, that's it exactly."

"So I'll tell you something we hardly ever get to hear."

"What's that?"

Linna brought her mouth close to Mike's ear and whispered.

"Welcome home."■

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Infinity Beach, Jack McDevitt, Harper, $25.00, 384 pp. (ISBN: 0-061-05123-3).

Bios, Robert Charles Wilson, Tor, $22.95, 208 pp. (ISBN: 0-312-86857-X).

The Stainless Steel Rat Joins the Circus, Harry Harrison, Tor, $23.95, 269 pp. (ISBN: 0-312-86934-7).

The Silk Code, Paul Levinson, Tor, $23.95, 319 pp. (ISBN: 0-312-86823-5).

Tamsin, Peter S. Beagle, Roc, $21.95, 275 pp. (ISBN: 0-451-45763-3).

Kaspian Lost, Richard Grant, Avon Spike, $24, 313 pp. (ISBN: 0-380-97672-2).

Through Alien Eyes, Amy Thomson, Ace, $13.95, 328 pp. (ISBN: 0-441-00617-5).

The Fantasies of Robert A. Heinlein, Robert A. Heinlein, Tor, $27.95, 352 pp. (ISBN: 0-312-87245-3).

Digital McLuhan: A Guide to the Information Millennium, Paul Levinson, Routledge, $27.95, 226 + xiv pp. (ISBN: 0-415-19251-X).

The Bedside, Bathtub & Armchair Companion to Sherlock Holmes, Dick Riley and Pam McAllister, Continuum, $19.95, 216 + xii pp. (ISBN:0-8264-1116-9).

Are we alone? We've been scanning the skies for years for radio signals from distant civilizations. There's a program to enlist folks with old satellite dishes in the search. SETI@ home (*http://www.setiathome.ssl.berkeley.edu*) has even turned the processing of picked-up signals into a home PC screensaver.

And we haven't found squat. Among the several possible reasons, we have to consider that we are in fact alone. That would comfort some people, who fear the Cannibals from Eta Carinae, but it would disappoint some as well. Surely the latter group includes most science fiction writers and readers, for whom Jack McDevitt wrote **Infinity Beach**.

The time is centuries hence, when humanity is spread across a number of terraformed worlds. Kim Brandywine, trained as an astrophysicist, works as a fundraiser for the Seabright Institute, a research outfit dedicated, among other things, to searching for aliens, or "celestials." They haven't had any more luck than we have, however, so despite a sense that humanity is retreating from its frontiers and growing content just to sit on the porch and rock, they are setting up an unmistakable billboard to announce our presence: they're blowing up half a dozen stars. The tale opens as they trigger the first nova.

Kim had a sister, an older clone, named Emily, who vanished right after the return of a failed exploratory mission. Other crew members died. A mountain blew up. A town was abandoned, and there are rumors that ghosts wander the deserted valley. One of Kim's old professors urges her to look into the ghosts, and—very reluctantly—she does.

As soon as she gets thoroughly spooked, the Astute Reader is pretty clear on just what the ghosts must be. It is no great surprise to learn that the log of Emily's ship has been tampered with, or that the son of one of her crewmates has a model of a very strange-looking starship. The resistance Kim encounters as she delves into the mystery is more surprising, and that is surely the thrust of the tale: Why the resistance? Why the coverup? Why does her lover have to

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die? And can the ancient dream be fulfilled at last? Can humanity be revitalized?

In her investigation, Kim is much luckier than she has any right to expect. She is intelligent and resourceful, and she has the help of friends, but her society is not nearly as paranoid as our own. Otherwise she would hardly be able to steal a starship (not once, but twice!). We can put that down to centuries of peace, or we can just refuse to worry about it, for her escapades keep the story moving briskly, and she is an easy protagonist to identify with. McDevitt has produced another very enjoyable novel.

Forty years ago in these pages, Harry Harrison's first published novel appeared. *Deathworld* (a trilogy before the decade was out) dealt with a human colony on a world whose life-forms were quite ferociously out to get the intruders, who defended themselves with guns and walls. The operative metaphor was that of being at war, under siege. The resolution involved learning to compromise, cooperate, to live at one with the alien nature.

Robert Charles Wilson's **Bios** is a modern *Deathworld*. There is a political backdrop—an Earth dominated by Families with the ethics of the Mafia, opposed by independent, freedom-loving Belters (but Kuiper, not Asteroid). There are high-tech ftl transportation (Higgs launchers) and communication (resonating particle pairs) whizmoes. But the key element is Isis, an alien world whose life never had its evolution disrupted by cosmic impacts and the like. Cells are highly evolved, complicated and fierce—and predaceous, and human visitors must be protected by bioproof armor and multilayered shelters. On the surface, it looks a bit like Harrison's vision, but the operative metaphor is more that of the plague lab, of Hot Zones and containment and avoidance of contact. Which makes sense—if an Isian bug gets to you, you bleed from every orifice, your flesh liquefies, and you die.

Enter Zoe Fisher, the last survivor of a clone group that went through hell. She was equipped as an infant with heavy-duty immune system boosters. She has a new high-tech protective suit to test on Isis. And she is eager to get out in the bush and get a close look at the indigenous Diggers, who live in underground burrows. First, however, she must get something going with one of the local researchers, Tam Hayes. A distant research station must fail as Isian life penetrates its seals. When the evacuees reach the orbiting command station and are quarantined, Isian bugs must slip past the barriers and begin to claim lives. And the research station that holds Zoe and Tam must feel its seals going. Isis is learning how to penetrate the barriers that protect humans.

And off Zoe goes to see the Diggers and be dragged into the burrows, where her suit is stripped from her. Will her immune enhancements protect her? Memory of Harrison's *Deathworld* and its resolution in cooperation led me to think that they would, that they would provide a better answer to Isis than interminable barriers. But modern writers are less optimistic or more realistic. Wilson says one cannot cooperate with such ferocity (I deliberately do not call it mindless): One needs better armor, more powerful defenses.

You'll enjoy this one.

Harry Harrison's Stainless Steel Rat, a thief and con artist who likes to keep his hand in even though he does now work for a secret law-enforcement agency, has been with us since 1957. Indeed, a Rat story was Harrison's very first sale to this magazine! Since then, the Rat, AKA Slippery Jim DiGriz, has roamed the galaxy, collecting boodle, tripping up villains, and generating novels and laughs.

Is **The Stainless Steel Rat Joins the Circus** the last in the series? It ends with "THE END?" for Slippery Jim is getting old and his lovely wife Angelina insists that it's time to retire. But he's still

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in fine fettle even if he does take a few more lumps than usual and Angelina is held in durance vile to make him serve a villain's wile.

It all begins when a picnic is interrupted by an onslaught of robot cops. Jim and Angelina blow them away until, down to their last shots, they await the end. What appears, however, is Imperetrix Von Kaiser-Czarski, alias Kaizi, the richest man in the galaxy and forty thousand years old to boot. He wants to hire the Rat—for a princely sum—to solve a rash of bank robberies. Jim quite naturally agrees, and soon, with the aid of his son's supercomputer, he has learned that the only factor shared by all the robberies was that the circus was in town.

Heigh-ho, then. Learn a spot of magic and sign up under the Big Top as it opens on the world of Fetorr, where the milk of human kindness soured long ago and there are far too many kinds of cops. A bank is promptly robbed, and Jim is framed, Angelina captured, and Jim instructed to rob the hitherto unrobbable.

He's in a bind. If he doesn't obey Kaizi, Angelina dies. If he does obey, he commits ingenious crimes—without profit!—and in the end, surely, they both die. He must obey, he must save his and Angelina's lives, and he must bring Kaizi down.

How he succeeds makes an entertaining light adventure.

When Paul Levinson's "The Mendelian Lamp" appeared in these pages (April 1997), I thought his take on Amish farmers as genetic engineers quite interesting. Firefly bombs are a bit of a stretch, but we really are learning that some quite wondrous things might be done with biological technologies and that the basic ideas don't demand high-tech labs to implement. With little more than insight, understanding, and patience, one might use very traditional selective breeding to accomplish marvelous things.

Levinson is guilty of a few more stretches in **The Silk Code**, and there's a lot of bafflegab as well, but overall it's a grand story with an eye to the vast sweep of time that reminds of Poul Anderson. The tale begins with that "Mendelian Code," which told us the good-guy Amish are fighting a biowar against fake Amish who have for centuries been working evil against the mass of humanity. The grand unanswered question was the reason for the war, and that is precisely where Levinson found his novel.

Part two drops back to eighth-century AD Xinjiang, where a man named Gwellyn is trying to find out why everyone insists on utterly destroying the occasional bodies of "singers" (whose thick bones and bulging brows immediately make the reader think of Neandertals). In his wanderings from Asia to Africa and Europe, Gwellyn learns of a people who communicate only in beautiful song. In due time, he finds the cave paintings of Spain and a people who can bring them to life to tell a tale of a happy people (Neandertals) slaughtered by newcomers (Cro-Magnons).

Back to the present, and New York City detective Phil D'Amato has a puzzle on his hands: a Neandertal corpse that carbon-dates as thirty thousand years old. There's another in London, another in Toronto. There are genetic anomalies, and a link to silk. And the investigators working on the scattered cases are dying! The war the Amish fight goes *waaayyy* back, and it is by no means over.

A biologist must criticize that Levinson makes his ancients far too knowledgeable about things—e.g., viruses—that require technological assistance to see and manipulate. Genes can be understood and manipulated bare-handed, so to speak, but not as genes. Selective breeding deals with phenotype, the visible features of the organism, and with long-lived creatures such as humans it must take such an inordinately long time as to destroy an essential component of the tale.

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A chemist must object to the idea of a virus that can transmute carbon-14 to affect carbon dating. But the same chemist might still save the story by suggesting that transmutation is hardly necessary; all that is needed is a biochemical process that differentiates between lighter and heavier isotopes (and there are such things).

A non-scientist will ignore such matters. Levinson slides deftly along, his characters quite interesting enough to arouse the reader's sympathies as lurking assassins await their chances, and the reader finishes the book feeling nicely satisfied.

Just when you think that Peter S. Beagle has a pattern (see, e.g., *The Innkeeper's Song*, reviewed here in April 1994, and *Giant Bones*, reviewed here in December 1997), he goes and does something different. His latest, **Tamsin**, is still fantasy and still excellent but is much closer to real life.

If, that is, you believe in ghosts.

The tale begins in New York City, where narrator Jennifer Gluckstein deals with life as the misfit teen daughter of divorced parents. Her father Nathan (stage-named Norris Groves) is a second-rank opera singer. Her mother Sally is a vocal coach and piano teacher who has something going with Evan McHugh, a British agricultural biologist. Natch, Evan proposes and Jenny's life turns upside down: a new Dad, two brothers, school and friends left in the dust, and a decrepit old Dorsetshire farm for a new home.

The farmhouse—a minor manor dating from the seventeenth century—of course has hidden rooms, strange noises (including voices under the tub), boggarts in the kitchen, and the Wild Hunt itself overhead on stormy nights. So much, Evan assures all, is just about normal, and he tells old folktales of pookas and the like. But Jenny soon finds there is a ghost as well.

I don't mean the ghost cat that quite enchants Jenny's Mister Cat. The one that matters is Tamsin Willoughby, who has lingered, waiting for release, for over three centuries.

What is her story? What does she await? What does it have to do with pookas and the Wild Hunt? Jenny does a bit of research and learns that in Tamsin's time, Dorset was the scene of a carnage to rival modern Bosnia. A rival claimant to the English throne had found adherents there, and when the battle was lost and the rival fled, King James sent George Jeffreys, Lord Chief Justice of Wem, to preside over what became known as the Bloody Assizes. Jeffreys delighted in agony, guilt was irrelevant, and the locals were hung and drawn and quartered and their parts mounted on pikes all over the shire.

And he dined in that minor manor, saw Tamsin, was smitten, decided that of course they were fated, and never mind that she loved another.

Enough, or I will spoil it for you. Beagle gives us here a marvelous tale of ancient evil, ancient love, eventual justice, and a witness who must somehow fit all the stuff of ancient superstition into a modern world. He is, of course, entirely successful and I hardly need to add that I recommend this one heartily.

Richard Grant dwells very clearly on the literary side of the science fiction landscape. Not for him the hard-edged stuff of Hal Clement or Greg Benford, nor the adventures of Frederik Pohl or Jack McDevitt. He's perfectly willing to be a social critic, but his mode is metaphor and image and pose.

One of his targets in **Kaspian Lost** is modern education, its purported failure, and the rhetoric of privatization that claims to respect each child's autonomy while strait-jacketing them with counselors and medications to fit a very corporate view of conventionality. The title character, Kaspian Aaby, is a classic innocent, a stalking horse through which the author can make his points.

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The stalk begins with Kaspian, whose raving conservative fundamentalist stepmother has reacted to his attempts at autonomy by punting him into a remedial summer camp to prepare him for the American Youth Academy ("an exciting private-sector alternative to the failed public school system") in the fall. He promptly gets fed up and walks into the Maine woods, sees a light, meets three evil leprechauns and a beautiful girl who may or may not do strange things with his body. He wakes up four days later and sixty miles away. Before the camp retrieves him (with his stepmother—full of guilt-inducing reproaches—in tow), he meets an aging hippie, her gay son Malcolm, and Weeb Eugley, an over-the-top investigator of alien abductions.

Poor Kaspian is now raw meat for the counselor Thera Boot who, like Eugley, strives to fit everything and everyone into preconceived patterns. So do Jasper Winot, the entrepreneur behind the AYA, and his politician friends. Success at fitting things into boxes means one is in control, one knows what one is doing and where one is going. Success in selling new sets of boxes to others means power and wealth. Things that don't fit are clearly problems in dire need of fixing.

Kaspian doesn't fit, doesn't want to fit, and doesn't want to be fixed. Yet he must live in a world that insists on fitting and fixing. Is there some resolution of the essential conflict? Perhaps not, says Grant. The future cannot be controlled, and we are all, to some degree, misfits. To know that is to be either insane or blessed.

Unfortunately, though Grant has interesting things to say, he does not show here the ability to hold the reader's attention well. The tale develops slowly, the most intriguing aspects (to an SF reader) turn out to be mostly red herrings, and the characters are not much more than lifeless postures.

Amy Thomson's **Through Alien Eyes** (the sequel to *The Color of Distance*) is a simple, straightforward tale marred by pedestrian prose. I have read more exciting newspaper articles.

Juna Saari, while exploring the world of Tiangi, had had her life saved by the apparently primitive but biologically sophisticated natives, the Tendu. Now she is on her way back to Earth, accompanied by her adopted son, a juvenile Tendu named Moki, and the elder Tendu Ukatonen. She believes both species have a great deal to learn from and a great deal of benefit to offer each other. Unfortunately, there are hidebound, conservative xenophobes at home who want nothing to do with aliens. When Juna's ship arrives in Earth orbit, it is kept in quarantine until she manages to unleash the power of the press. Only then can she return to the bosom of her loving family and demonstrate the healing powers of the Tendu. She also discovers that—thanks to the Tendu having undone her contraceptive protection when healing her, and to an unprotected lover—she is pregnant, and births are rigidly controlled in order to reduce the human population below crisis level. She must defend herself in court to earn the right to have her child.

Meanwhile, Moki is being a child, learning everything in sight, being jealous of the baby, and so on. Ukatonen is working with physicians and ecological restorationists; in both cases, his Tendu talents stir tremendous excitement. In due time, that excitement gets Juna and the Tendu kidnapped by pro-natalist terrorists, but they manage to escape and all is well in the end.

Both Tendu characters are as innocent as Grant's Kaspian. Thomson is thus able to comment on many of humanity's foibles as they explore our ways, making a great many friends and a few deadly enemies. Unlike Grant, she also realizes that the very features that create problems for us are also strengths for which the Tendu can like us.

Yet as heroes go, Juna Saari is not a very compelling or memorable charac-

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ter. Indeed, every one of Thomson's characters is little more than a passive speaker of scripted lines, lacking all passion, verve, and life.

Robert A. Heinlein of fond memory was more than a seminal science fiction writer. He also wrote a number of wonderful stories for *Astounding* and *Unknown Worlds*, which were collected in a pair of old books. The stories in *The Unpleasant Profession of Jonathan Hoag* (1959; Berkley, 1976), containing the title story, "The Man Who Travelled in Elephants," "All You Zombies," "They," "Our Fair City," and "And He Built a Crooked House," dealt in such things as the fourth dimension ("House"), time travel ("Zombies"), and sentient whirlwinds ("City"). The first of those in *Waldo and Magic, Inc.* (Doubleday, 1950; Pyramid, 1963) is also clearly SF; in fact, it gave us the term "waldo" for remote manipulators. But the second is the quintessential rational fantasy, magic as engineering.

Why lump all these stories as The Fantasies of Robert A. Heinlein? Perhaps it's just they were a bit out of his usual territory, a bit less connected to the rational world of engineers and space travel and so on. But it hardly matters, for they are now available once more. If you—like me—have them only in the form of tattered paperbacks, rejoice, for you can now put a durable hardbound on your shelf. If you remember them vaguely or—worse yet—never heard of them before, order your copy immediately. You're going to have fun.

Media theorist Marshall McLuhan was once a byword. When television was still young, he declared that the medium was the message, announced the coming of the Global Village, measured the temperature of radio as hot and TV as cool, and—just before his death in 1980—promulgated four laws to govern transitions between media. Yet he was criticized for speaking in inchoate metaphors ("loose, shaggy buffaloes" in the words of one critic), and he said himself that he didn't explain—he explored. As a result, says Paul Levinson in **Digital McLuhan: A Guide to the Information Millennium**, he was much misunderstood.

Or was he perhaps a man ahead of his proper time? *Wired* magazine declared him its patron saint, and it is Levinson's thesis that "the digital age is both well explained by McLuhan and helps bring McLuhan's ideas into sharper focus—i.e., McLuhan makes more sense when reconfigured for the digital age."

It seems unlikely that anyone is better suited than Levinson to do that reconfiguring. He met McLuhan when he was getting his doctorate as a media theorist and has written much on the man and media theory since then. He strikes me as quite enamoured of McLuhan but still willing to criticize and reinterpret as appropriate to explain the grip the Web has upon us and to sketch some future possibilities. In the process, he makes a good case for his thesis even if he can't quite bring himself to kill off all of those loose, shaggy buffaloes.

It has long been noted that science fiction readers tend to be fond of Sherlock Holmes stories. The Bedside, Bathtub & Armchair Companion to Sherlock Holmes, by Dick Riley and Pam McAllister, is therefore worth calling to your attention.

Besides short summaries of every Holmes story, the book contains biographical material on both Conan Doyle and Holmes, essays on parodies, pastiches, artists, and Sherlockian societies, background on Holmes's Victorian world, quizzes, maps, puzzles, a crossword, and more. If you're a Holmes fan, you'll love it.

Nota bene: The authors have also committed *The New Bedside, Bathtub & Armchair Companion to Agatha Christie*, available from the same publisher.■

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BRASS TACKS

Dear Jeff [Kooistra],
Concerning the problem you posed in the September 1999 Alternate View column, I don't recall any warning about steel armatures going the wrong way in the rail gun literature, but since steel is ferromagnetic, I suspect that what happens is that the steel becomes magnetized in the opposite sense of the applied field, and that the magnetization from that is stronger than the magnetic field of the current going through the wire, which would otherwise drive the steel armature down the rails.

[I'll note that if you hold a steel or iron bar in rough alignment to the Earth's magnetic field and strike it (to loosen up the magnetic domains, I suppose) it will be magnetized in the opposite sense of the Earth's field and strongly enough to pick up filing dust or to move paper clips—much more intense than the Earth field that caused the original magnetization.]

If I'm correct, cast iron and alnico would exhibit the same behavior if used as armatures. Once upon a time, I could have worked this out quantitatively on the spot after looking up permeabilities, etc. But that would be an all-day project now, so I'll have to settle for the qualitative suspicion. Thanks for the interesting problem.

GERALD DAVID NORDLEY

Jeffery D. Kooistra replies:

There seems to be quite a bit of interest in the retrograde railgun issue—enough that I might as well devote a column to it. I was more interested in having people try to find something about the problem in the literature than to have them try to figure it out themselves, but that's OK.

There's some truth to what Mr. Nordley says—railgun armatures are astonishingly complicated places of E&M business. With some materials, retrograde motion can occur simply because the material is attracted to the magnetic field inside the rail-armature "box," enough so that this force is stronger than the Lorentz force pushing the armature away. (One reader nicely nailed this fact and demonstrated it by experiment—but he didn't have a reference to the effect either.)

But this isn't the whole story. As it turns out, you can engineer an armature to go either way, and rather robustly at that. But I'll save that discussion for another time.

JEFFERY D. KOOISTRA

Dear Stan,

As a scientist on the funding treadmill, I simply have to weigh in on your September editorial. Theoretically, of course you're right that limits on funding will result in cheaper ways of doing things. So why do "lab" paper towels cost $5.00 a roll while the supermarket's best is one quarter of that? Because the real incentive in the system is to make everything as *expensive* as possible, not cheaper. The main priority of professors is to obtain large grants because this is their main avenue of advancement. The universities themselves acquire large sums of money through the "overhead" (or administrative costs) included in these grants, so deans are also desperate

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for professors to get the largest possible grants. Tenure, merit pay raises, and promotions are all dependent on bringing in the most money. (And I'd be very surprised if status didn't follow money outside of universities as well.) The suppliers overcharge for everything from paper towels to analytical equipment because nobody really cares how much things cost. One, the grant is paying for it, and two, the more it costs, the more grant money you can ask for. There is a pattern here.

What can we do about it? One thing I am sure of is that we have to scrap the current methods of funding science. They're corrupting research into scientific fads established by bureaucrats. The fact that any good science comes out of this system is evidence of the love of truth and the disregard for wealth that still lurks among many scholars.

I'm much less clear on how we *should* be funding science. (I don't know if the humanities are in equal straits. I suspect so, but I hope not.) One essential element is to prevent researchers from being fundraisers for universities. There should be *no* overhead associated with funding (beyond actual costs, which are closer to 1 percent than the approximately 50 percent that is normal). Once the professors' bosses can no longer milk them for money, the bosses' priorities will change, and hence also the professors'. Yes, I know this is likely to mean fewer professors, and god knows what else, but the current system is not a healthy growth.

On the positive side, it may be worth trying a system where money is provided without any further strings attached. As long as the money is used for research it can be used any way the scholar sees fit, and over as long a period as he or she can stretch it. In other words, it would be like having your own money in the bank (with restrictions on what it can be spent on) and it would benefit the researcher to save money. This might also allow researchers to do work that is not immediately understood by funding agencies. This would be a good thing. For every ninety-five wild goose chases we mad scientists would go on, there might be one where an obscure student of medieval Czech literature finds out what the alchemists really meant.

Any radical reorganization is difficult, and even dangerous. Without the incentive of research money, deans would be forced to give professors enough time to be something other than teaching machines. Universities would need direct funding to replace some of their lost slush funds. There are many ramifications. But I, for one, can't wait to see reform start—before progress grinds to a complete halt while we all do the same original research as everyone else.

DR. MIA MOLVRAY
Norman, OK

Dear Stan,

As usual, I found your editorial in the September issue to be very interesting. I would like to point out a great example of scientists finding creative ways around budget cuts that most *Analog* readers would find interesting, if they don't already know about it. It's a freeware screensaver available off the net called SETI@home.

What this program does is download a batch of data collected from SETI to your personal computer. Then you can either let it process the data in the background while you use your computer normally, or you can assign it as your screensaver and it will only process the data when the screensaver kicks in. When the data has been processed you will be prompted to establish an internet connection. The results are uploaded, and a new batch of data is retrieved.

What better way to cut the cost of computer time than to get thousands of people around the world to do it for you for free? And the type of people interested in the search for extraterrestrial intel-

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ligence is just the type who would love the chance to help in this way. Amateur astronomers have a long history of adding valuable data to the science . . . asteroid and comet hunting, timing variable stars, timing occultations, and other such things. Now any web surfer can contribute with no more special knowledge than how to download a program and install a new screensaver . . . very trivial skills.

The program is available from *http://setiathome.ssl.berkeley.edu/* as well as many online screensaver archives, C|Net, Sky & Telescope, and many others.

GARY W. MITCHELL
flithiss@southwind.net

Dear Dr. Gillett,

"Unresources" was an interesting article, although I am unable to take your stand on Mercury (Hg) for a few reasons. Few insurance companies have included composite (white) fillings for posterior (back) teeth as covered benefits. As a result, thousands of amalgam (silver) fillings are done every day in the US alone. The media has informed us about the small content of mercury in silver fillings. Unfortunately, lots of insurance companies will not give *any* benefit toward a filling if it is not amalgam, and not many patients are willing to pay the additional $20 to $100 to have composite fillings.

The compressive, tensile, and shear strengths of amalgam are pretty different than those of composite. The fact is, amalgam holds up longer for most posterior fillings. The future may prove different (I hope), but right now, people with dental insurance and those on the government dole are being "encouraged" to use amalgam for their fillings.

I am just a dentist and I didn't set the prices. I just see what I see.

CHRIS MARSHALL, DDS

Dear Brass Tacks:

David Lester's letter in the September 1999 issue stunned me. I am not surprised when people miss editorial points (I've been known to do it . . .), but trying to censor what an editor writes is a whole 'nother ball of neutronium.

Is Lester aware that Bill Clinton made it into one of Michael Flynn's novels? Is he aware of alternate history SF? Does he comprehend that SF is about life and what we do with it? I may not agree with an editorial, but I'll die to defend the editor's right to say whatever comes to mind. Remember where you live, Mr. Lester!

THORNTON KIMES
1415-1/2 E. John
Seattle WA 98112

Dear Dr. Schmidt,

I have been reading science fiction since I was a young girl. I read stories about rocket ships going to the Moon and Mars at the same time that it was happening in real life. Science fiction has always been an important part of my life. It has helped me to have a mind open to change, and I believe it played an important role in my upbringing. With the influence it has had on my life, I find myself sharing stories from *Analog* with friends during discussions about all kinds of things. One of my friends is a woman over fifty; she has considered herself to not be scientifically inclined, or able to understand much of modern science. If I mentioned something about quarks or black holes I could see her eyes start to glaze over.

Then I loaned her one of my *Analog* back issues. Now she is addicted. Every time I see her, she wants to borrow more of my back issues. I am now working on getting her to subscribe herself. The best thing about this was when this same woman sat in my living room and discussed Universal String Theory with me. Now she has a much higher opinion of herself and of her ability to grasp scientific theories.

This change is all due to reading science fiction that is, in my opinion, of

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the highest quality available today. I have only subscribed to *Analog* for about six years now, but I don't know how I lived without it for so long.

Keep up the good work.

PAT BATTSON
Mesa, AZ

Dear *Analog:*

We all get old. Where is that bright-eyed kid who first read *Dune* in the pages of *Analog?* The kid who dreamed of traveling to the Moon and to Mars. I am over fifty now and my eyes are starting fade; more so than most since I have R.P. I have to read my *Analogs* now using a magnifying glass, in spite of the fact that I have my eyes checked regularly and wear bifocals. While others of my generation are not as bad off, many are wondering why the print on their favorite magazine seems to be shrinking with each passing year. When you went to the slightly larger format recently, I had hoped that you would have increased the font size as well. No such luck. Where is your large print edition? I do not see it listed anywhere on your web page or in your hard copies subscription choices. If paper costs are the issue, I would gladly be willing to foot the bill in order to keep reading my favorite magazine. That kid is still inside me, still dreaming of voyages to strange worlds, still hoping that he can share the ride on which *Analog* has taken him.

WILL MULLEN

Paper costs are only part of the problem, but we regret that, at least for now, we cannot supply a larger print edition (though I believe there are Braille and/or audio versions; ask the Library of Congress). Eventually, I suspect (and I emphasize eventually*), we may have an electronic edition that everybody can read in his or her favorite form*

Dear Sirs,

It has always seemed to me a logical next step for science fiction publications to get into the business of making their publications available in electronic format. I remember years ago, before the PC was cheap and ubiquitous, when *Analog* magazine offered all of their back issues on microfilm. I thought this was the greatest idea ever. I was still in grade school at the time and could not afford the reader or the microfilm, but I thought that this was surely the way things were going.

Now I can purchase every *National Geographic* and *TIME* since the first issue on CD-ROM and run them on my standard PC or Mac. Why aren't the science fiction magazines keeping up?

Half the stories in your magazines are filled with this kind of technology. Now that it's accessible by the average reader at no significant cost increase, why not do it?

Why can't I pay a couple of dollars a month to download *Analog* or *Fantasy and Science Fiction* to my Palm Pilot in DOC format?

Science fiction magazines talk a good technology game, but when it comes down to realizing the technology, you are being left far behind, when you really should be the cutting edge.

You guys don't even have interesting web sites.

EZRA DWECK

I'm sorry you don't find our web sites interesting. A lot of people do, but we're always interested in suggestions on how to improve them.

As for a CD-ROM of our entire run of back issues, I agree that it would be a nice thing to do, but it's nowhere near as easy as it might seem. National Geographic *and* Time *have always been very high-budget operations with large staffs and the ability to produce their magazines in highly durable form. Much, if not all, of their material is either staff-written or bought from freelancers on terms that enable the magazines to control more of the rights than we can. Science fiction magazines have*

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always operated on much smaller budgets, buying only the specific rights for which they could anticipate a need and commonly printing on paper that becomes relatively fragile with age. If we wanted to produce a CD-ROM of Astounding/Analog, *we would have to obtain rights we do not already have to an enormous number of stories, articles, and pieces of art; and somebody would have to scan all that into a computer from originals that in many cases could not survive the process. We simply don't have the resources to do that, much as we would like to. (We anticipated lots of other technologies we're not in a position to implement, too!)*

Recent development: *Dell Magazines has entered a trial agreement with Peanut Press to offer* Analog Science Fiction and Fact *on the Palm Pilot and similar organizers. Starting with the January 2000 issue, Palm users were able to download the contents of the issue and read it at their leisure. Other Dell magazines being offered by Peanut Press are* Asimov's Science Fiction, Alfred Hitchcock's Mystery Magazine, *and* Ellery Queen's Mystery Magazine. *Visit* http://www.peanutpress.com *for more information.* ■

IN TIMES TO COME

Certain types of human beings, it seems, will make anything into a sport, especially if it's a bit crazy. Climbing Mt. Everest? Sure. Jumping a motorcycle across a row of trucks, or a canyon? Why not? Diving a spacecraft as close as possible to a black hole without getting pulled in? That one might seem to be going a bit too far, but Michael A. Burstein has vividly imagined a way it might happen, and the kinds of human problems it might create, in our lead story for March, "Escape Horizon"—which, in turn, inspired a dramatic cover by Bob Eggleton.

The biggest story in the issue is Ben Bova's novella "Death on Venus," wherein two people are drawn to that deadly planet for the same ostensible goal, but for very different personal reasons. We'll also have a new and curiously timely "Ray and Rokey" story from Ramona Louise Wheeler, plus stories by Paul Levinson and Rajnar Vajra.

Our fact article will be Dr. M. Todd Washington's "Proteins and Protein Engineering: The Wet Side of Nanotechnology." Nanotechnology has gotten lots of attention in recent years as a likely candidate for the next (and quite likely the biggest) revolution in human technology. Yet nature has been practicing it for a long time—we ourselves constitute an "existence proof"!—and some of the first big human steps may be taken by building on what nature has already done.

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UPCOMING EVENTS Anthony Lewis

18-20 February 2000
AD ASTRA 2000 (Toronto area SF conference) at Primrose Hotel, Toronto, Ont. Guests of Honor—Nancy Kress, Fred Saberhagen, Charles Sheffield; Artist Guest of Honor—Bob Eggleton; Fan Guests of Honor—Lloyd & Yvonne Penney. Info—PO Box 7276 Stn. A, Toronto ON M5W 1X9, CANADA URL—<http://terra.phys.yorku.ca/~white/adastra>

18-20 February 2000
BOSKONE 37 (New England Science Fiction conference) at Sheraton Framingham, Framingham, MA. Guest of Honor—Michael Swanwick; Official Artist—Rick Berry; Special Guest—Peter Weston; Featured Filker—Jordin Kare. Registration—$36 until 17 January 2000, higher at the door. Info—PO Box 809, Framingham, MA 01701 phone—(617) 265-2311. email—<boskone@nesfa.org> URL—<http://www.nesfa.org/boskone>

25-27 February 2000
CONFLUENCE 2000 (Pittsburgh area SF conference) at Sheraton Inn, North Mars, PA. Registration—$25 until 1 January 2000, $35 at the door. Info—PO Box 3681, Pittsburgh, PA 15230 phone—(412) 344-0236. email—<parsec-home@netcom.com>

25-27 February 2000
POTLATCH 9 (Seattle area SF conference) at University Plaza Hotel, Seattle, WA. Registration—$30 in advance, more later. Info—PO Box 31848, Seattle, WA 98103 URL—<http://www.galaxy-7.net/squib/corflatch/potltch9.html>

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31 August-4 September 2000
CHICON 2000 (58th World Science Fiction Convention) at Hyatt Regency, Chicago, IL. Guests of Honor—Ben Bova (former editor of *Analog*), Bob Eggleton, Jim Baen, Bob & Ann Passovoy; TM—Harry Turtledove. Registration—$150; supporting $40. [These rates are good as of 1 October 1999; they may go up again. These are the latest posted rates as of the time this column went to press.] This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info—Chicon 2000, Box 642057, Chicago, IL 60664. email—<info@chicon.org> URL—<www.chicon.org/>

26-29 October 2000
WORLD FANTASY CONVENTION 26 at Omni Bayfront, Corpus Christi, TX. Guests of Honor—K. W. Jeter, John Crowley; TM—Joe Lansdale. Registration—$90 until 7 November 1999, then more. Info—WFC 2000, Box 27277, Austin, TX 78755. email—<fduartejr@aol.com>

Convention runners: If your convention has a telephone, FAX, email, or Web page URL, please let us know so that we can publish this information. ■

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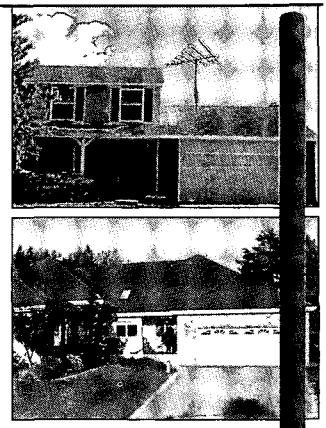
TECHNOLOGY UPDATE

Stealth antenna hides under gutters but performs like big ugly antennas

The new Max Antenna by GE is the low-profile, high-gain way to get flawless reception of broadcast signals without expensive installation.

by Hope Chapman



The Max Antenna by GE is the ultimate TV antenna system.

Electronic engineers agree—your television is only as good as the signal it receives. Unfortunately, antenna design has not kept pace with improvements in television quality and the features available. Both cable and satellite television systems have spent a great deal to improve the quality of their transmission, but they can be extremely expensive, they aren't available in all areas and may not provide access to local TV stations. Luckily, there is a new antenna from GE that will provide breakthrough performance without making your family room look like something out of the fifties.

Clear alternative. The Max Antenna series from GE uses a revolutionary electromagnetic design to maximize installation flexibility and yield longer range reception of off-air VHF and UHF signals. Unlike a conventional dipole antenna, the Max Antenna can receive signals in both vertical and horizontal planes with minimum cross-polarization loss. This design allows for the first low-profile antenna solution that provides numerous installation options.

Superior components. The key to the superiority of this antenna is its ingenious use of the latest electromagnetic technology—providing high gain and full channel coverage as well as the greatest amount of mounting flexibility. First, the antennas were designed around a wide band element to achieve the greatest amount of gain in a relatively small space. Next, an amplifier and matching network was designed to enhance the reception of weak signals. This amplifier also adds very little distortion to the strong signals, giving it a balanced amount of gain. A filter on the amplifier board will allow for good matching between the antenna and amplifier. Special attention was paid to design an antenna-amplifier combination that would be completely compatible with the new digital transmission format. It has been designed for strong signal distortion rejection and a low amount of noise. It is omnidirectional and requires no adjustments, orienting or fine tuning during use. You simply install it, set it and forget it.

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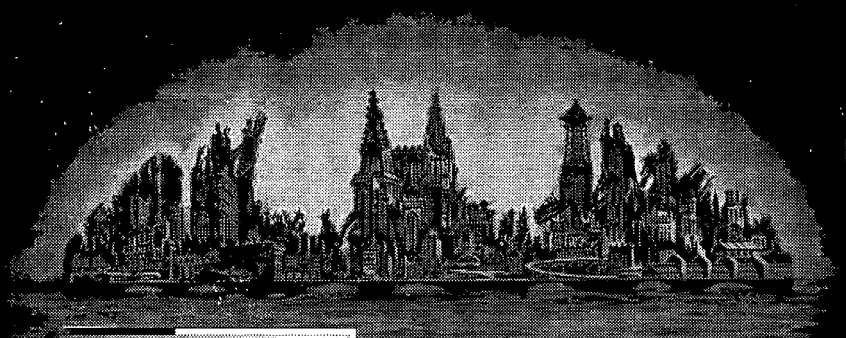

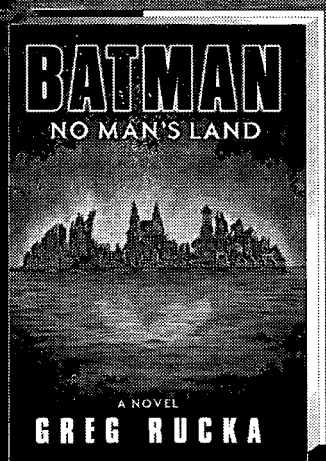

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